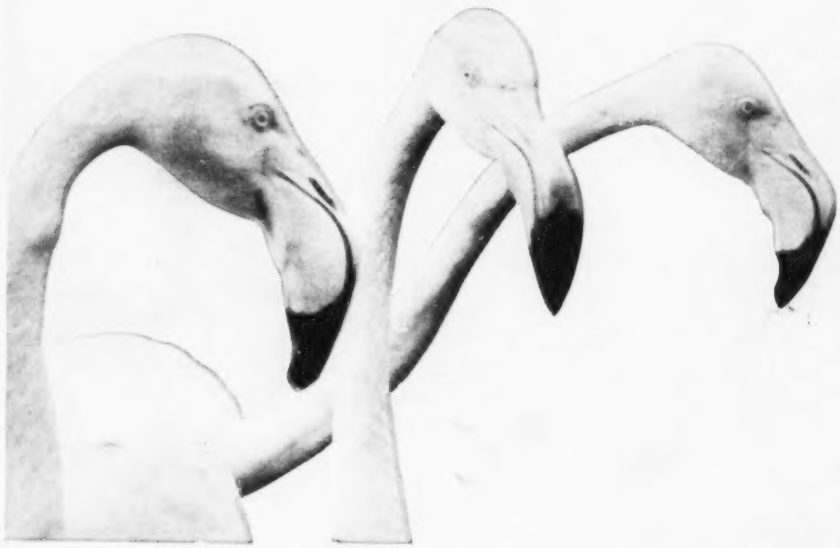
14 AUGUST 1959

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS



Most unusual . . . . ha, ha, ha!

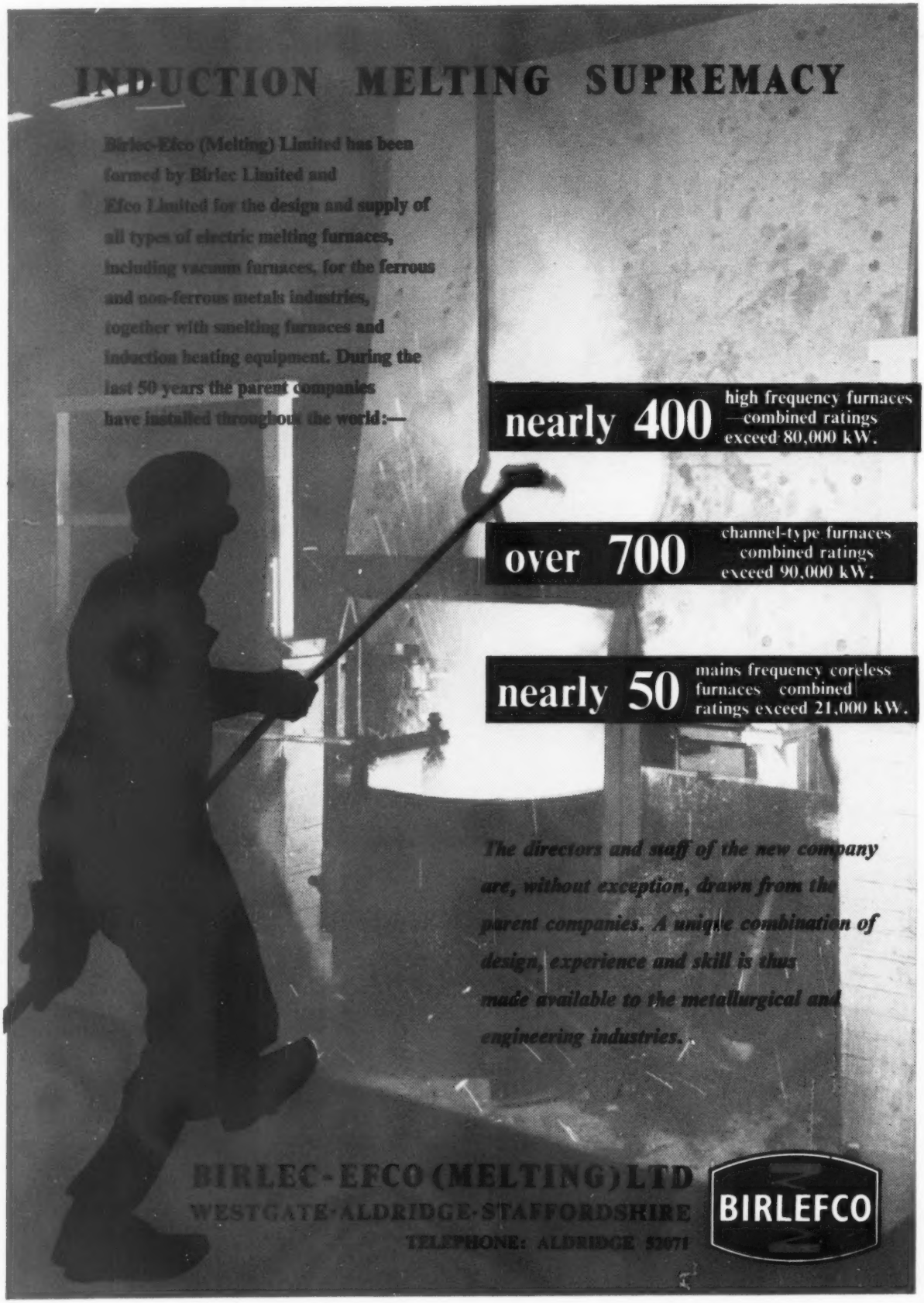
Frankly the purpose of this advertisement is to bring to your notice that our prices for non-ferrous ingots of the highest quality may well be a good deal cheaper than those you are already paying—and our deliveries are exceptionally good, too. Then why the three old feathered clerics? Well, we thought that at first sight you might be rather more interested in them than in us. But now we have come this far together, may we send you particulars of our production facilities and details of our very keen prices?

Platt METALS LTD

PLATT METALS LIMITED · ENFIELD · MIDDLESEX · HOWARD 3351

VOL 95 No 1

ONE SHILLING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Birlec-Efco (Melting) Limited has been formed by Birlec Limited and Efco Limited for the design and supply of all types of electric melting furnaces, including vacuum furnaces, for the ferrous and non-ferrous metals industries, together with smelting furnaces and induction heating equipment. During the last 50 years the parent companies have installed throughout the world:—
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over 700 channel-type furnaces combined ratings exceed 90,000 kW.
nearly 50 mains frequency coreless furnaces combined ratings exceed 21,000 kW.
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Our delivery vans are literally on National Service —making daily deliveries of W.M. non-ferrous ingots to every county, and almost every corner, of Britain. Non-ferrous founders know by experience that in specifying W.M. they can be sure of non-ferrous metal and alloy ingots conforming in every particular with the most exacting specifications.

for ingots of consistent reliability

Branches at: London, Birmingham, Manchester, Glasgow, Leeds, Cardiff, Newcastle-upon-Tyne.

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Unceasing research and strict quality control, at all stages of production, ensures that Intal Light Alloy Ingots can always be depended upon. The quality never varies. With over a quarter of a century's experience and progress, Intal maintain all the newest techniques in scientific inspection, and make use of the most advanced instrumentation in ensuring that the Intal high standard of quality is **consistently maintained.**

INTAL

Light Alloy Ingots

These illustrations are taken from the latest Intal booklet, giving much interesting information on alloy ingot manufacture. We shall be pleased to post a copy to executives on request.

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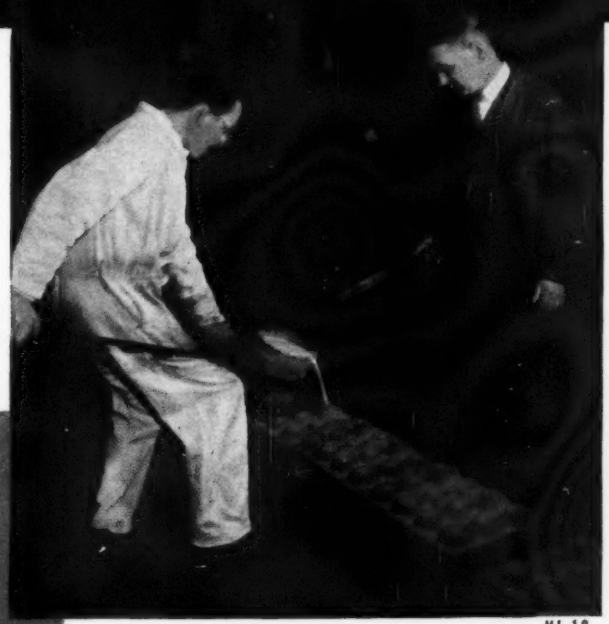
HAYDON HILL, AYLESBURY, BUCKS. Telephone: Aylesbury 4242. Telex. 15/520 Cables: Intalloyd, Aylesbury



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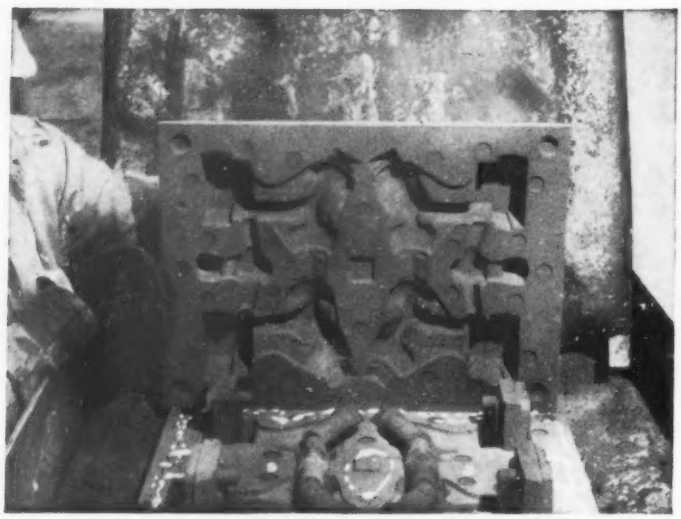

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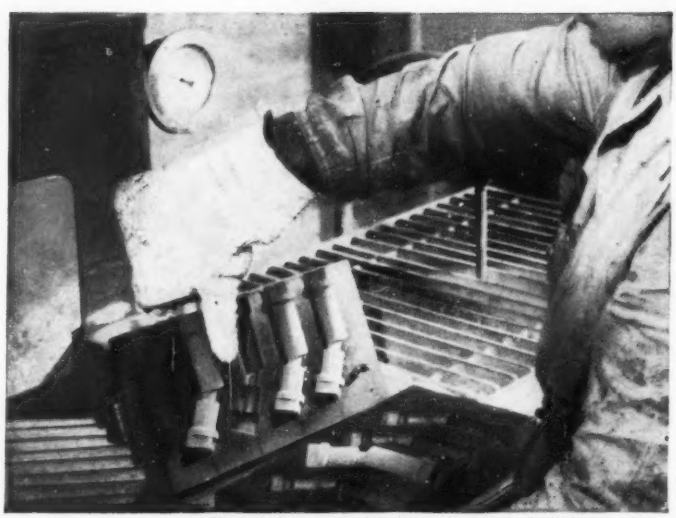

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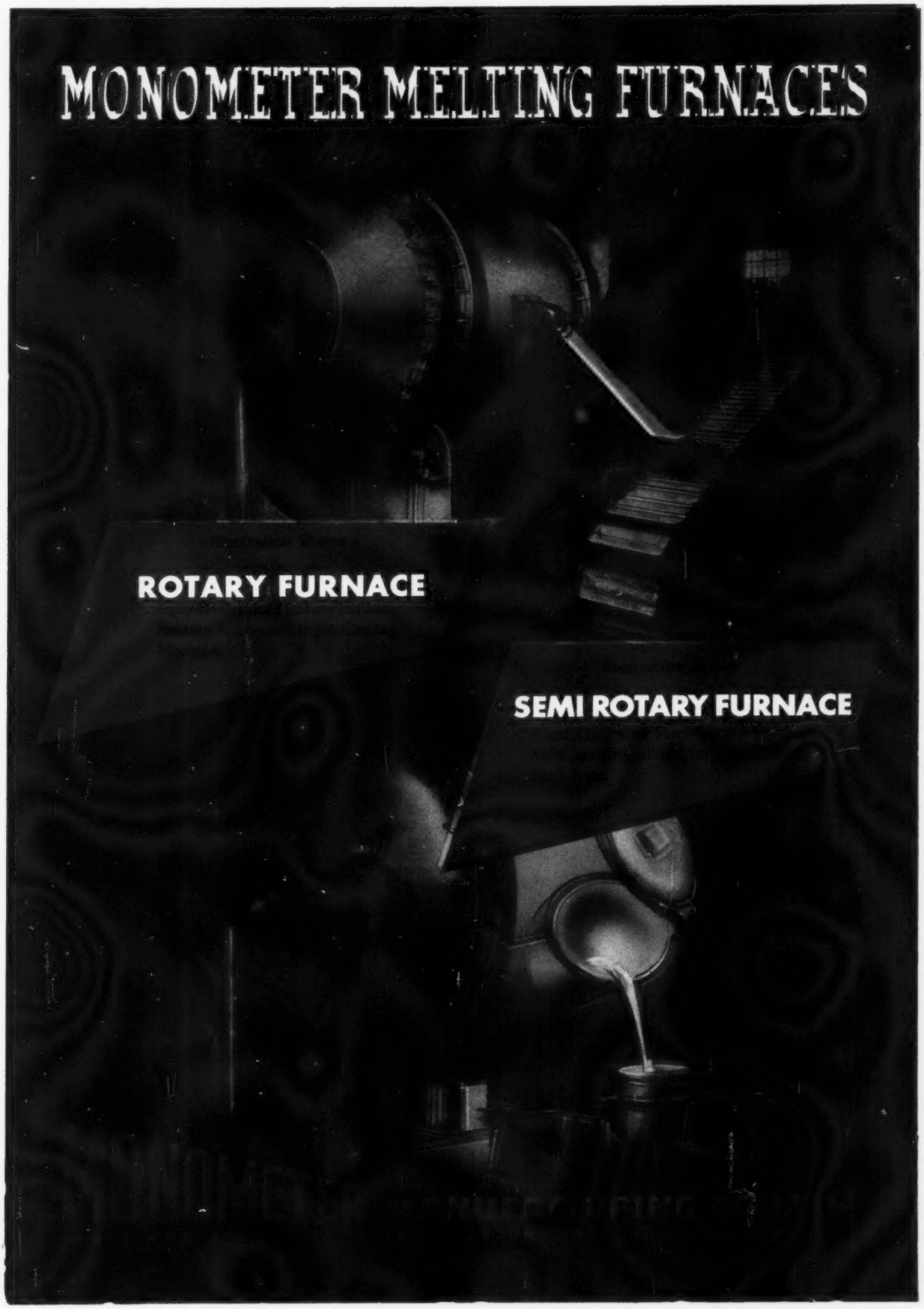
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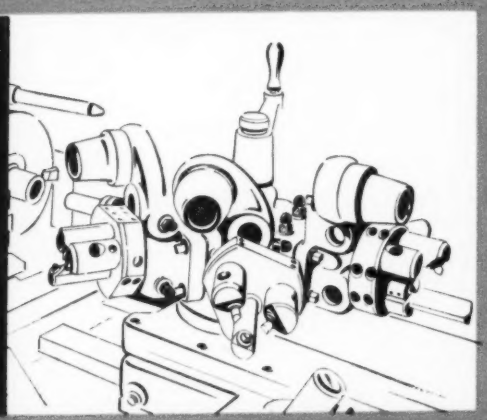

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- High strength Bronzes and Brasses with good machining properties.
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- Alloys produced to all British and other standard specifications.

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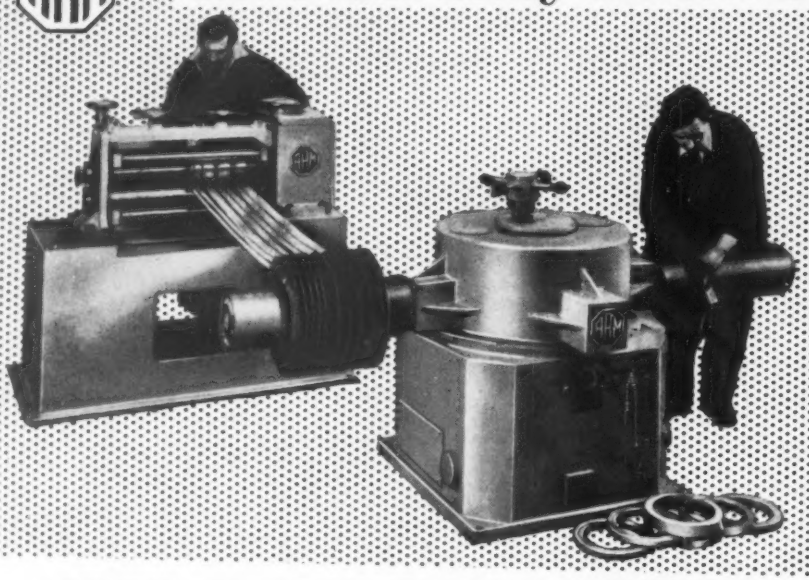
P.2283

ARM

Modern Slitting Machines



No. 6 size Slitter
24" wide

SPACER LOCKING ARRANGEMENT
Easily accessible

PATENTED STRIPPING ATTACHMENT
Eliminating strip scratching
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DOUBLE HEAD CAPSTAN COILER
Giving increased production

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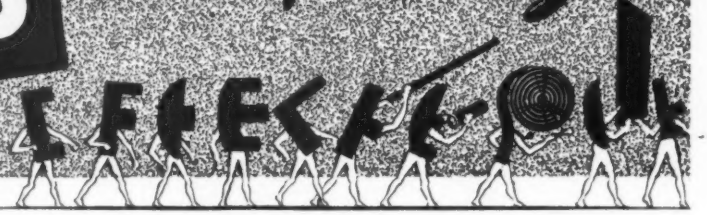

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If you want to get on in this world it's very important to listen to the voice of experience, or if you happen to be an up-and-coming hippo, follow respectfully in its rear. At risk of seeming ponderous we at Park and Paterson claim a great weight of experience in our particular and specialized line, the production of non ferrous ingots to B.S.S. or any special analysis. We should be delighted to place it at your disposal.

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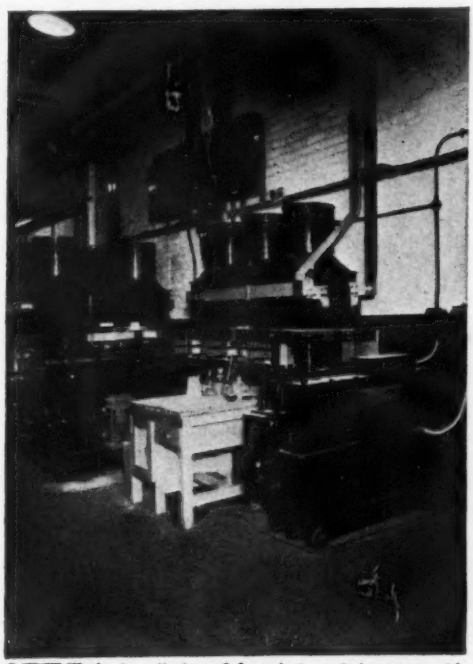
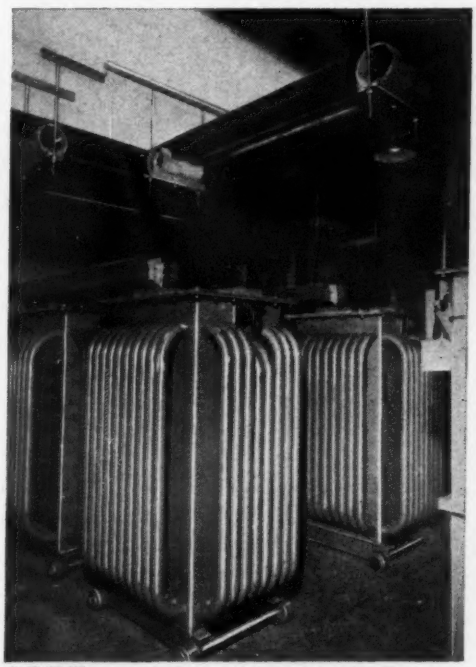
EXPERIENCE

is your Guarantee for all Rectifier problems



1935 *An installation of forced-air-cooled copper-oxide rectifier sets providing 15 000A for electrolytic plating at the works of Messrs. Rudge Whitworth, Hayes, Middx.*



1957 *Four oil-immersed 12V plating rectifier sets supply 8000A for etching processes in the production of capacitor foil at the Swindon works of The Plessey Company.*

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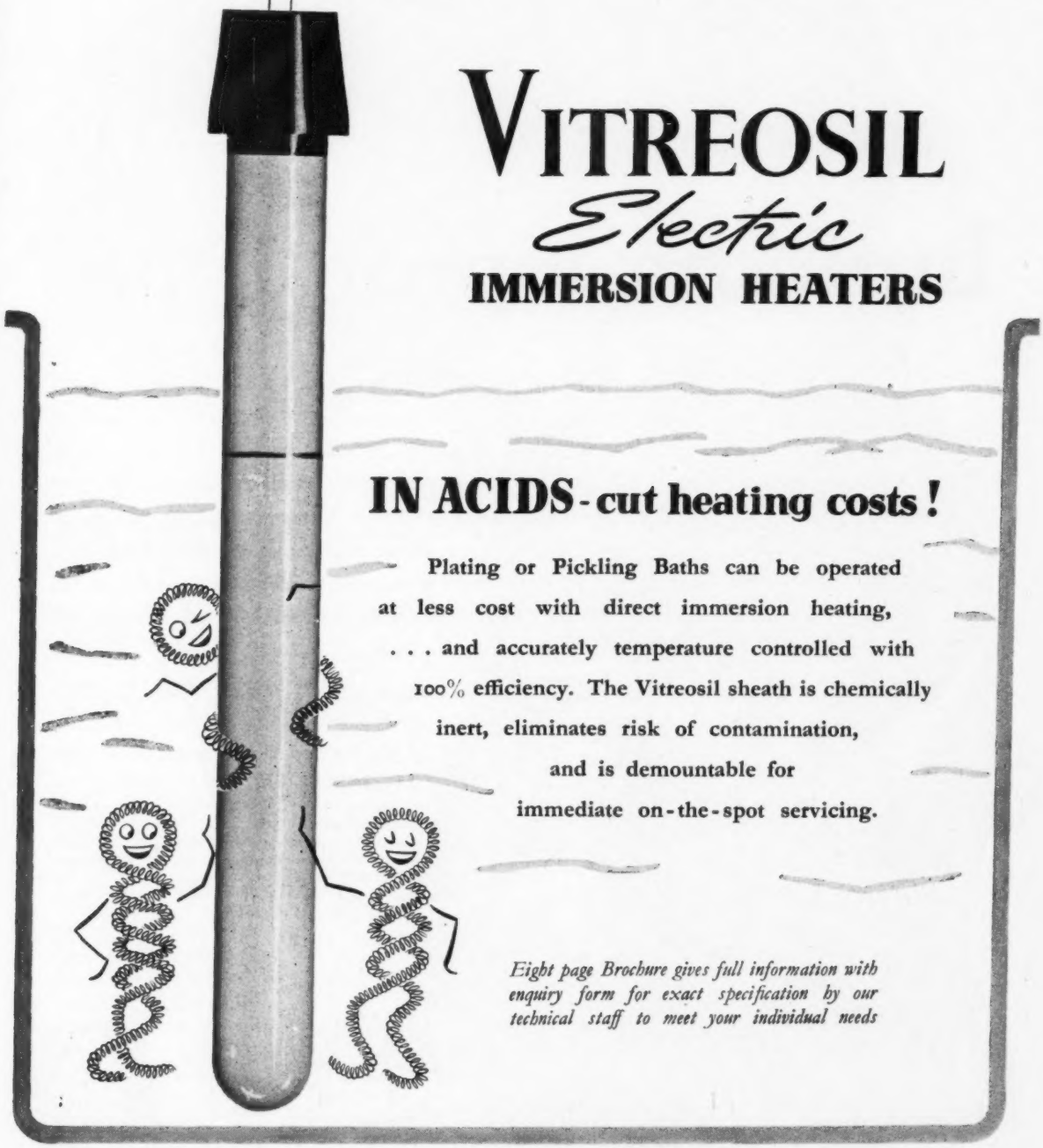
Electric
IMMERSION HEATERS



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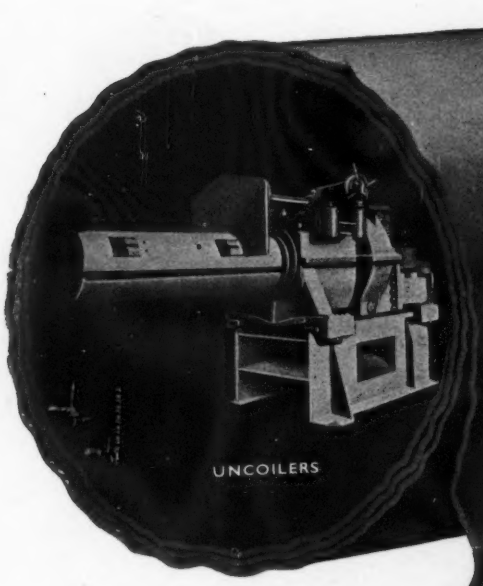
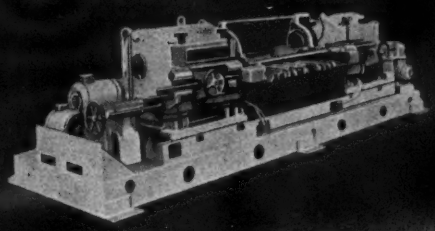

UNCOILERS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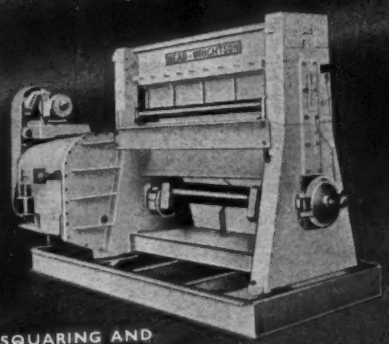
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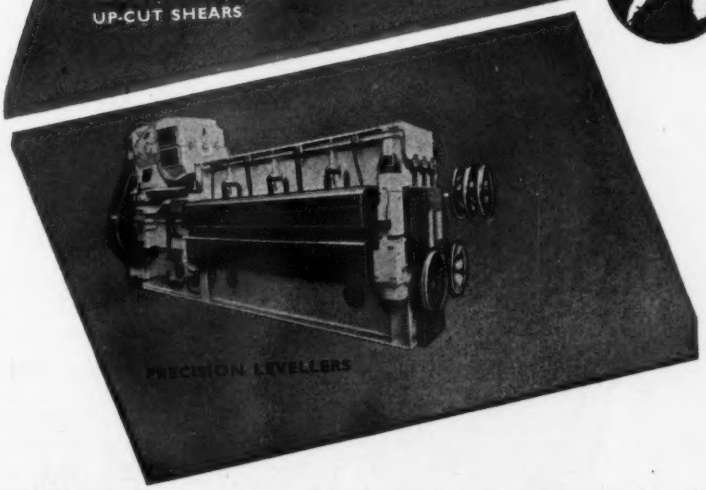
These machines are examples from the extensive range of equipment built by The Head Wrightson Machine Company for steel and non-ferrous metal production and fabrication. In these fields, Head Wrightson machines are effecting significant economies and increased production. Our engineering and manufacturing resources are always available to deal with your special requirements.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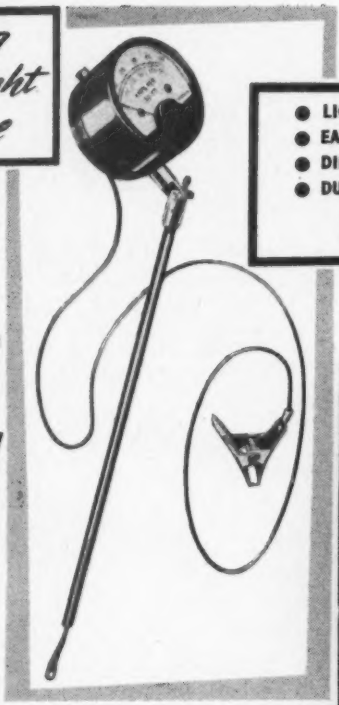

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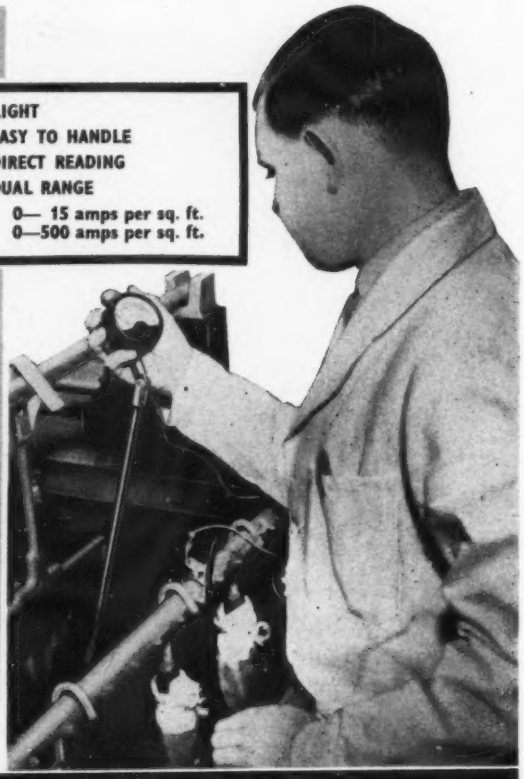

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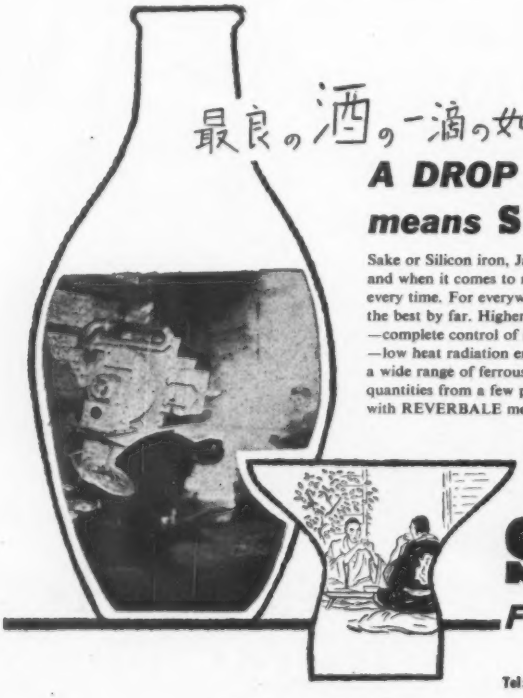

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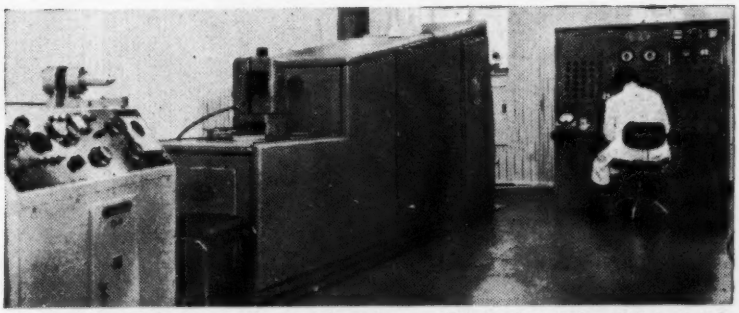

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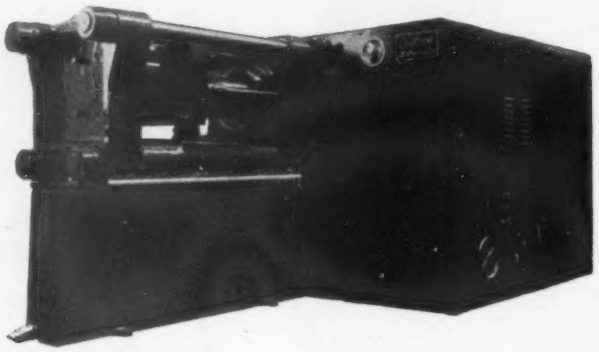

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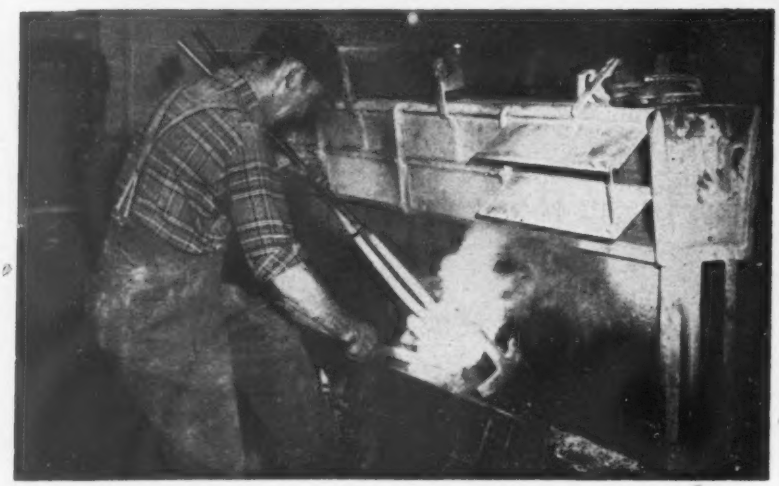

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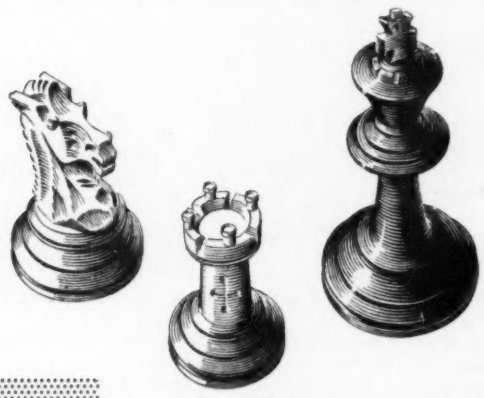

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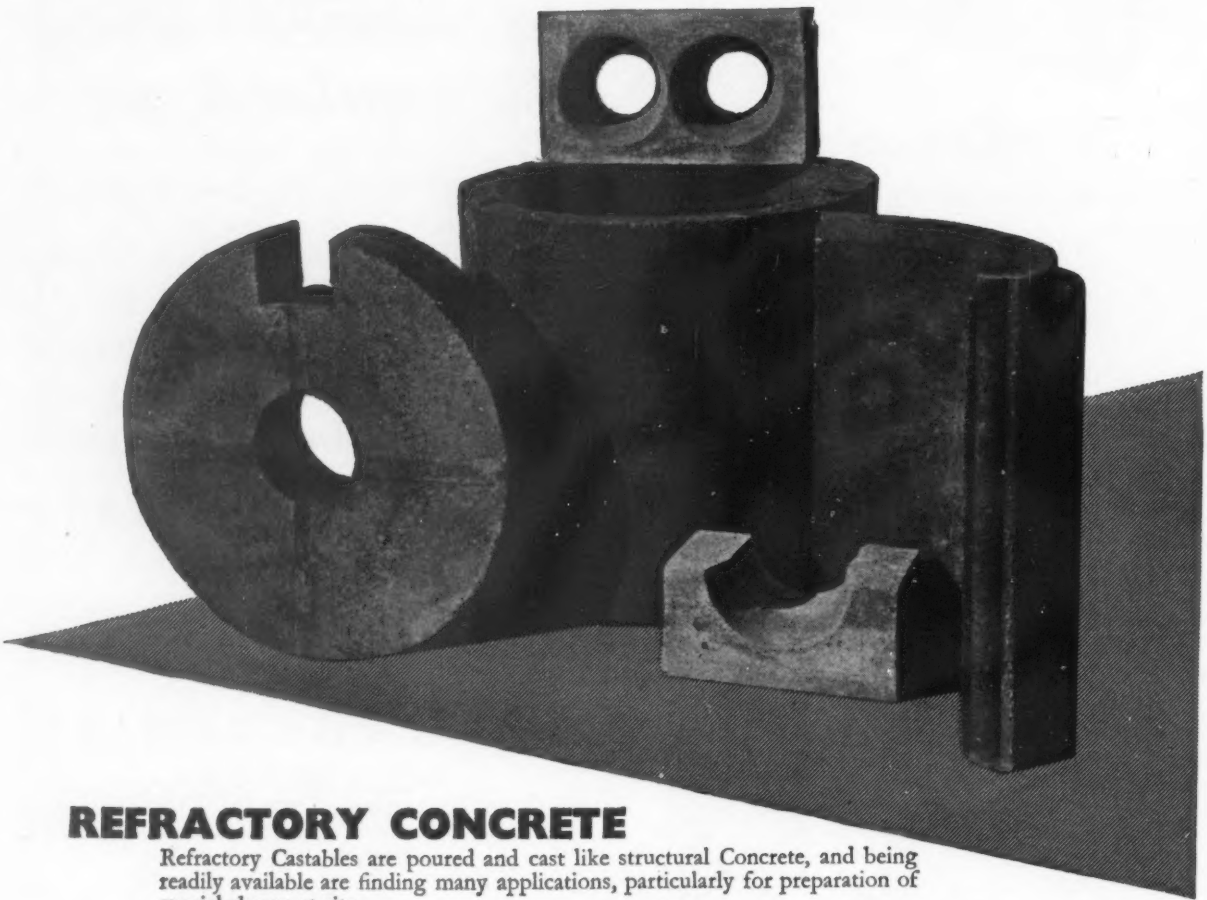

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METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

14 AUGUST 1959 VOLUME 95 NUMBER 1

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METAL INDUSTRY

VOLUME 95 NUMBER 1 14 AUGUST 1959

Industrial Hazards

WITH factory accidents at their lowest level for twenty-three years being in 1958 some 4 per cent lower than in the previous year, the Chief Inspector of Factories, in his recently published Annual Report, congratulates industry on a further achievement in its attempt to ensure that factories are safe places in which to work. He adds, however, that satisfactory as this general fall may be, the figures—167,697 reported accidents in 1958 of which 665 were fatal—are still too high. The distribution of accidents between the sexes and between young persons and adults has changed little from the previous year but, the Report adds, "it is still true that in certain industries the probability of having an accident is greater for a young person than for an adult." The present developments in the training of young persons in accident prevention as part of their technical education are, therefore, more than welcome.

For the second year in succession there was an increase in the number of accidents associated with the use of power presses, notwithstanding the great efforts that have been made to evolve better designs and methods of guarding. It is obvious that there is need for still greater effort, particularly in the maintenance of the machines and their guards. Unfortunately, too, there was a slight increase in the number of electrical accidents but as these fluctuate considerably from year to year there is probably no particular significance in the increase during 1958. An analysis of the accidents in relation to the type of plant and apparatus on which they occurred showed that those caused by portable and transportable electrical apparatus and their accessories formed the largest proportion. This proportion has remained fairly constant for the past six years, portable apparatus being responsible for about 40 per cent of the fatal and about one-third of all electrical accidents. There was a welcome decrease of about 10 per cent in the number of injuries to the eyes. Where these were caused by molten metal and other hot and corrosive substances or by ejected particles from process machinery they could in most cases have been prevented by the use of suitable goggles or screens. In this connection the work of the Joint Advisory Committee on Foundry Goggles should materially help in reducing the number of eye injuries due to molten metal.

The Report draws attention to the increasing quantities of liquid mercury used in industry and notes that the development of new processes has involved handling the metal on a large scale. Several cases of mercury poisoning have occurred, illustrating the need for improved techniques in controlling the vapour hazard and for dealing with the problem of decontaminating buildings and equipment where mercury has been carelessly handled. A new method for decontaminating workrooms in which mercury has been spilled is referred to in the Report, which also sets out the basic precautions which should be taken in handling the metal.

In a separate Report on industrial health attention is drawn to two industrial processes which can produce health hazards. The first, chromising, the use of which is expected to expand considerably, can produce dust which might involve health dangers. The second, the increasing use of beryllium-copper alloys, causes concern because a chronic form of beryllium poisoning may arise after exposure to very low concentrations of beryllium oxide fume or dust. The Report advises that the only safe practice is to aim at complete suppression of dust or fume.

Out of the MELTING POT

Remoter Connection

IT seems to be a characteristic of modern research that the further it advances, the further it tends to move from whatever it is that is being studied. It has, for example, been moving further and further away from all the excitement stirred up a few years ago by the discovery of the remarkable properties of metal whiskers. In those days, whiskers grew spontaneously on metal surfaces, they were examined under a microscope, and they were tested by bending and pulling, and it was concluded from the extremely high elastic properties that they must be very nearly perfect crystals. There was also some elementary speculation as to how such whiskers grew. One was left hoping that research would go on, and that one would learn more about the properties of whiskers and that even, who knows, some practical use of metal whiskers might develop. This latter hope was strengthened when the slow and unpredictable spontaneous growth of metal whiskers was supplemented by methods of growing whiskers much more rapidly by the method involving the deposition of high-purity metal vapours and the method based on the hydrogen reduction of metal halide salts. Unfortunately, research on metal whiskers also continued to advance, with the result that metal whiskers were soon left far behind. Today, research is concerned with the structure and growth mechanism of metal whiskers. Thus, for example, X-ray rocking curves obtained for tip grown iron whiskers produced by hydrogen reduction of liquid iron halide salts have been interpreted as showing that the more perfect whiskers have dislocation densities below 10^6 dislocation lines per sq. cm. This would mean that many of these whiskers which are less than 10 micron in diameter would contain, at most, only a small number of dislocations and should behave as perfect crystals. The results also provided evidence disproving the screw dislocation growth mechanism, but failing to decide between other possible mechanisms. There was also some evidence suggesting that still greater purity of the materials used could serve to achieve further improvement in the perfection of the crystals. One is therefore again left hoping that possibly on the occasion of the production of these purer metal whiskers something will be said about these "better" whiskers themselves.

Partly Chemical

REGULAR readers, if any, of this page may recall occasional comments to the effect that the present-day tendency to regard the behaviour of metals under stress, and in particular under fatigue stresses, as a purely physical phenomenon is unjustifiably narrow, excluding as it does the probability of the chemical interaction between the metal surface (and in particular the nascent portions of the surface produced by slip) with atoms of the surrounding medium, and the effects of such interaction. I was therefore pleased, and faintly amused, to find that the incidence of chemical interaction and its effects has, it appears, recently come to the notice of scientists at the Naval Research Laboratory in Washington, paradoxically enough through the absence of such effects in a vacuum. It is indeed a pleasure to be able to quote one of these scientists who "revealed that materials undergo unexpected structural changes when tested in a vacuum in an attempt to duplicate conditions of outer space. Some metals tested at NRL grow stronger, some weaker in a vacuum, and other characteristics as creep and fatigue are altered." A theory has been advanced to explain the behaviour of materials in the NRL tests. "According to this hypothesis, two surface reactions between a material and air are possible. In one reaction, the surface of the material strengthens and hardens by oxidation. In the other, the surface cracks. A material is stronger in air or in a vacuum depending on which of these reactions dominates. Finishes may inhibit surface cracks and lead to appreciable increases in ultimate strength . . . . a surface finish entirely impermeable to air would significantly heighten the strength of steel and make molybdenum one of our most valuable structural materials."

Actually Hardened

FOLLOWING the discovery of SAP (sintered aluminium powder) with its high mechanical properties especially at elevated temperatures, and with its resistance to recrystallization, much interest has been taken in dispersion-hardened materials of which SAP is the typical example. Such materials derive their high mechanical properties from the presence of a finely-dispersed second phase which is usually a material stable at high temperatures (such as aluminium oxide in the case of SAP). They are, from the structural point of view, related to the previously well-known precipitation-hardened materials in which the increased mechanical properties are the result of a finely dispersed phase precipitated by an appropriate heat-treatment. Attempts have been made to explain the effect of the particles of the dispersed phase on the mechanical properties of both dispersion-hardened and precipitation-hardened materials in terms of interferences by the particles with the movement of dislocations in the slip planes. Pointing out that so far such attempts have not been really satisfactory, R. A. Huggins, of Stanford University, California, has recently suggested that the observed effects in both precipitation-hardened and dispersion-hardened systems are caused by the generation of dislocations and effective work hardening of the matrix. The change in properties is therefore due to this work hardening of the matrix rather than to the interaction of dislocations with the particles or their strain fields. There is, in fact, much X-ray evidence of plastic strain occurring in the matrix during age hardening. In a number of systems the second phase causing the age hardening is in the form of platelets which are coherent with the matrix in two dimensions, but not in three. As a result, shear stresses can develop during the process of particle formation and cause dislocation generation and work hardening of the adjoining matrix. In the case of dispersion-hardened materials, in which there is no coherency between the particles and the matrix, it is suggested that the shear stresses necessary for work hardening of the matrix may arise from the strongly anisotropic thermal expansion of the particles. An evaluation of this expansion and of the resulting stresses shows that no very large temperature change is necessary to produce stresses of the magnitude required to cause slip in the matrix. Additionally, of course, there is the effect of the particles of the dispersed phase on the annealing behaviour of the dispersion-hardened material.

Skimmer

TENSILE STRENGTH — ELONGATION — IMPACT PROPERTIES

Aluminium Alloys at Low Temperatures

By L. MORI

A series of investigations into the low temperature properties of a range of aluminium alloys showed that in most cases an improvement was produced at sub-normal temperatures. The investigations were carried out at the Instituto Sperimentale dei Metalli Leggeri and the article has been specially translated from "Aluminio" for publication in this journal.

A PRECISE knowledge of the behaviour of metals at sub-normal temperatures is of value both as a further means of studying the physical state of solids and as an aid to the development of metallic materials suitable for the increased applications at sub-normal temperatures created by modern techniques. The phenomenon of embrittlement in steels caused by changes in the structure of the crystal lattice with decrease in temperature is well known and has led to much work on the development of special steels more resistant to embrittlement at low temperatures. Such modifications, however, do not occur in face-centred cubic alloys which have been shown to be stable down to the lowest temperature obtainable in the laboratory and aluminium alloys, which are face-centred cubic, enjoy this stability.

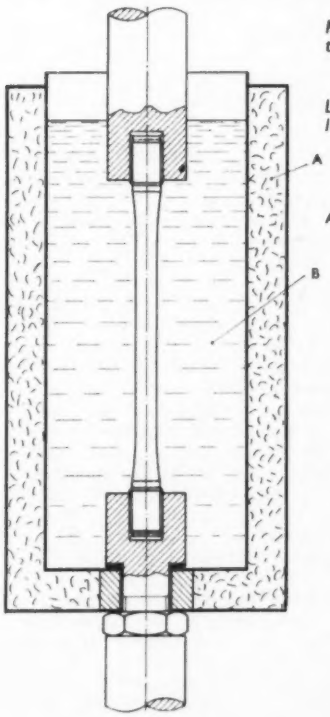
It is not often possible to predict the mechanical properties of metallic materials at sub-normal temperatures from their room temperature properties and so tests have been carried out on the most widely-used standard wrought light alloys in various conditions of heat-treatment at seven temperatures which ranged from room temperature to −195°C. Parallel impact and tensile tests were conducted at each temperature. The results are illustrated and discussed in this article.

Description of Tests

The alloys examined were all wrought alloys in various conditions of heat-treatment, namely: 1. Commercially pure aluminium in the annealed and ¼ hard conditions. 2. Peraluman 35—A non-heat-treatable and corrosion-resistant aluminium-3½ per cent magnesium alloy in the annealed and ¼ hard conditions. 3. Avional 24—A high strength aluminium-4.4 per cent copper-1.5 per cent magnesium alloy in the annealed condition and in the solution-treated and naturally-aged condition. 4. Anticorodal 11—A medium strength corrosion resistant aluminium-0.9 per cent silicon-0·7 per cent magnesium-0·5 per cent manganese alloy, in the fully heat-treated condition. 5. Ergal 55—A high strength aluminium-5·8 per cent zinc-2·5 per cent magnesium-1·6 per cent copper alloy, in the fully heat-treated condition.

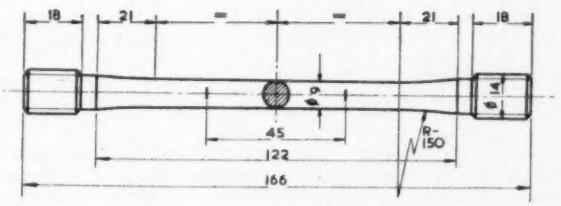
All the material used for the low temperature tests was well within the appropriate specifications of the Unificazioni Italiane (Italian Standards) for chemical composition and for room temperature mechanical properties. The material in the form of 16 mm. diameter rods was heat-treated before the test pieces were machined, the shape and dimensions of the tensile test pieces being illustrated in Fig. 1. Impact tests were effected on standard Mesnager test pieces but anomalous results were obtained for certain of the alloys at some temperatures and it is suggested that specimens with a deeper notch such as those of the Charpy type should be used for low temperature impact tests on light alloys.

The jig employed for the tensile tests is represented schematically in Fig. 2. Essentially, it consisted of a double tank lagged with natural wool flocks. The test piece, immersed in the cooling liquid, was mounted coaxially with the two tanks. Test temperatures were chosen to correspond as often as possible to the boiling points and freezing points of the refrigerating liquids in order to achieve



Left: Fig. 2—Jig used for the low-temperature tensile test

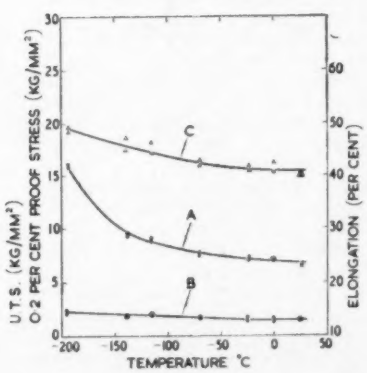
A—Wool Flock. B—Refrigerating Fluid

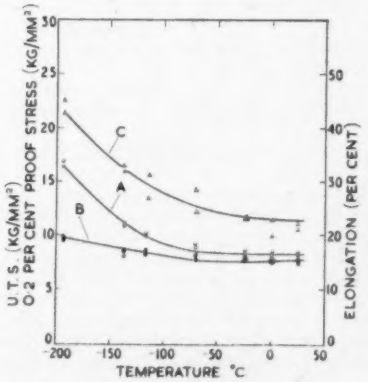


Right: Fig. 1—Form of the low-temperature tensile test piece

Figs. 3 and 4—Variation in mechanical properties with temperature. Left: Fig. 3—annealed commercially pure aluminium. Right: Fig. 4—hard commercially pure aluminium

A—U.T.S. (kg/mm²). B—0·2 per cent proof stress (kg/mm²). C—Elongation (per cent)





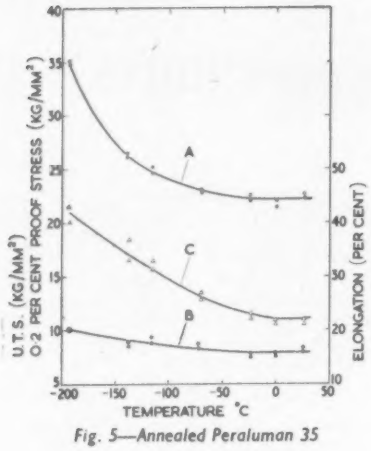


Fig. 5—Annealed Peraluman 35

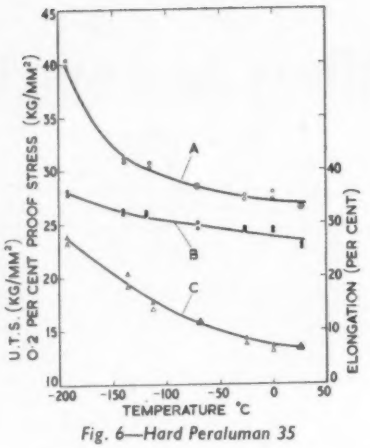


Fig. 6—Hard Peraluman 35

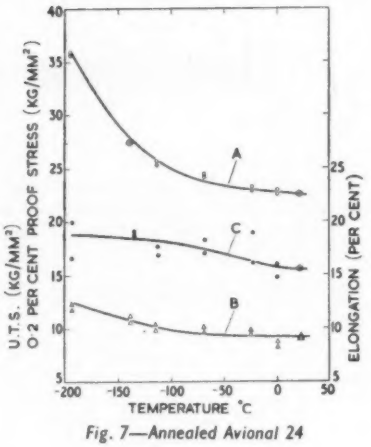


Fig. 7—Annealed Avional 24

Figs. 5-10—Variation in mechanical properties with temperature

A—U.T.S. (kg/mm²). B—0·2 per cent proof stress (kg/mm²). C—Elongation (per cent)

Fig. 8—Naturally-aged Avional 24

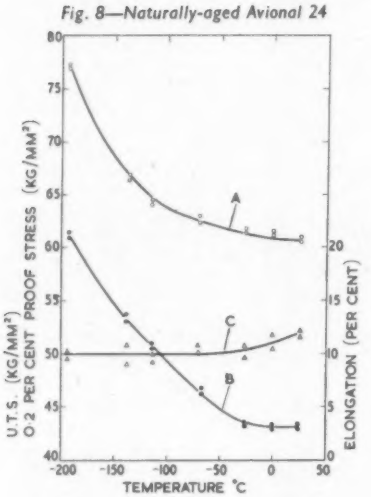


Fig. 9—Fully heat-treated Anticorodal 11

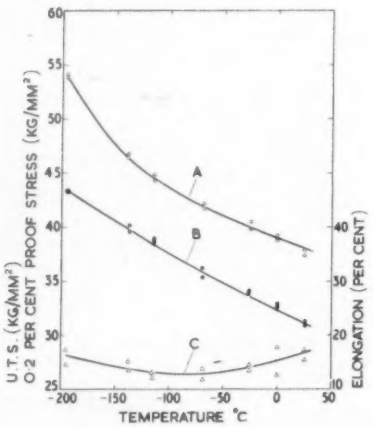
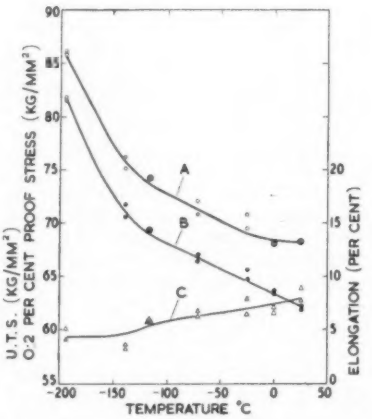


Fig. 10—Fully heat-treated Ergal 55



greater reproducibility and constancy in testing conditions. The temperatures employed were as follows:

78°K.=−195°C. Boiling point of liquid nitrogen.

135°K.=−138°C. Freezing point of ethyl chloride (cooled by liquid nitrogen).

158°K.=−115°C. Freezing point of ethyl ether.

203°K.=−70°C. Temperature of a mixture of ethyl ether and solid carbon dioxide.

248°K.=−25°C. Temperature of ethyl ether cooled with solid carbon dioxide.

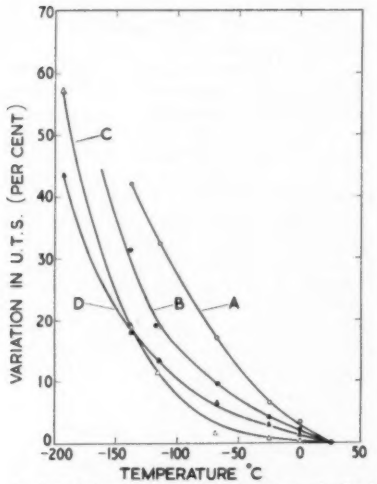
273°K.=0°C. Temperature of melting ice.

Before testing the specimens were held in the cooling medium at the desired temperature for about 15 min.

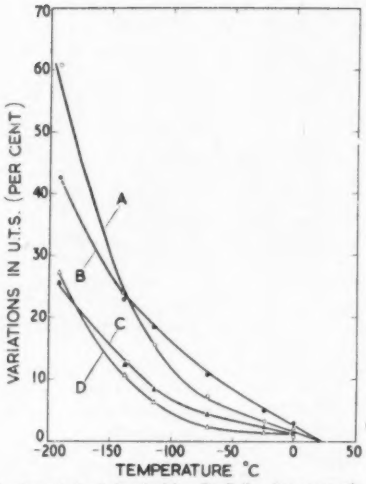
No special jig was necessary for the impact tests. Specimens were held at constant temperature in the refrigerating mixture for about 15 min. and then rapidly removed and tested. In order to carry out the operation as speedily as possible a standard procedure was adopted so that for all the test pieces the time between withdrawal and breaking did not exceed 5 sec.

Tensile Test Results

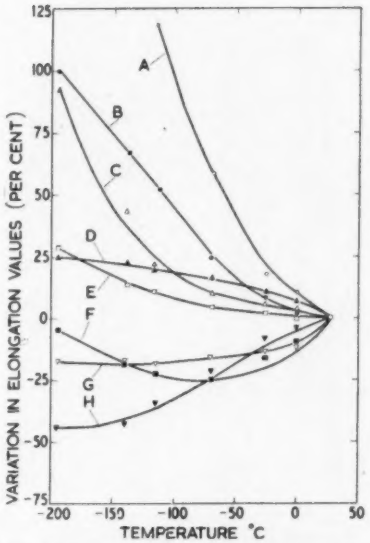
Tensile tests were carried out in duplicate, each of the values obtained being illustrated in Figs. 3-10. The materials examined could be divided into two classes according to their behaviour at sub-normal temperatures. The word "materials" is used in preference to "alloys" because their behaviour depends upon their previous thermal treatment. The first group included those materials in which neither 0·2 per cent proof stress, ultimate tensile stress nor elongation decreased with decrease in temperature, whilst the second group comprised those materials for which decrease in temperature resulted in an increase in ultimate tensile stress and 0·2 per cent proof stress and a decrease in elongation. All the non-heat-treatable alloys and the heat-treatable alloys in the annealed condition, namely, commercially pure aluminium, both annealed and hard; Peraluman 35, both annealed and hard and Avional 24 in the annealed condition only belonged to the first group. Thus, there was a variation in properties common to materials in which the alloying elements were not in solid solution but were present in the form of precipitated particles. Proof stress seemed to increase only slightly or else not at all at sub-normal temperatures, but ultimate tensile stress and elongation increased markedly. The heat-treated alloys which comprised the second group were: Avional 24 solution-treated and naturally aged; Ergal 55 fully heat-treated, and Anticorodal 11 fully heat-treated, which differs slightly in behaviour from the other two. For alloys of the second group decrease in temperature caused a marked increase in 0·2 per cent proof stress which was often greater than the increase in ultimate tensile stress.



A—Annealed commercially pure aluminium. B—Hard commercially pure aluminium. C—Annealed Peraluman 35. D—Hard Peraluman 35



A—Annealed Avional 24. B—Fully heat-treated Anticorodal 11. C—Naturally aged Avional 24. D—Fully heat-treated Ergal 55.



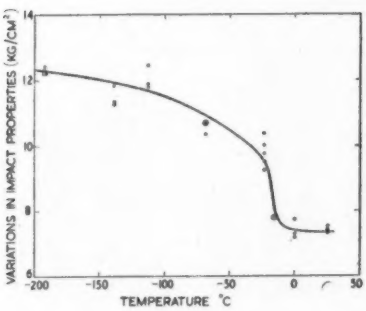
A—Hard Peraluman 35. B—Annealed Peraluman 35. C—Hard commercially pure aluminium. D—Annealed Avional 24. E—Annealed commercially pure aluminium. F—Fully heat-treated Anticorodal 11. G—Naturally aged Avional 24. H—Fully heat-treated Ergal 55

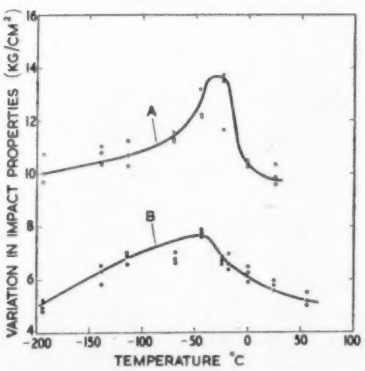
Figs. 11—13—Percentage variation in ultimate tensile stress with test temperature

The shape of these curves was comparable with those encountered in materials which undergo structural changes in the crystal lattice at low temperatures, for example, many types of steel. It was considered that further study of these phenomena was not within the scope of this investigation but the connection between the presence of solute atoms in the crystal lattice and the marked variation in proof stress was considered particularly noteworthy.

The heat-treatable alloys had very high strength at the temperature of liquid nitrogen, whilst still retaining good ductility, values for ultimate tensile stress and 0·2 per cent proof stress of 86 Kg/mm^2 (54·6 tons/in^2) and 82 Kg/mm^2 (52·1 tons/in^2) respectively being obtained for fully heat-treated Ergal 55 and 77 Kg/mm^2 (48·9 tons/in^2) and 61 Kg/mm^2 (38·7 tons/in^2) respectively for naturally-aged Avional 24.

As a further means of evaluating the results, the amount which each property varied at each test temperature was expressed as a percentage of the value obtained at room temperature, the final values being plotted in Figs. 11-13. Variation in elongation values, shown in Fig. 13, are particularly interesting. There was a clear division between alloys in which variation in elongation increased and those in which it decreased, thus emphasizing the difference between the two groups of alloys already described.





Figs. 14—17—Variation in impact properties with temperature

Left: Fig. 14—Hard commercially pure aluminium

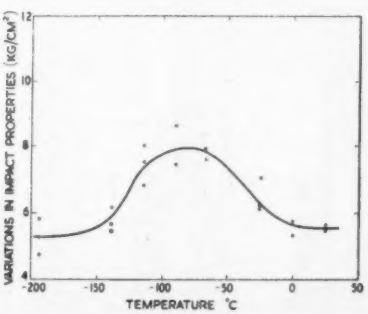
Below left: Fig. 15—Hard and annealed Peraluman 35

A—Hard. B—Annealed

Below centre: Fig. 16—Fully heat-treated Anticorodal 11

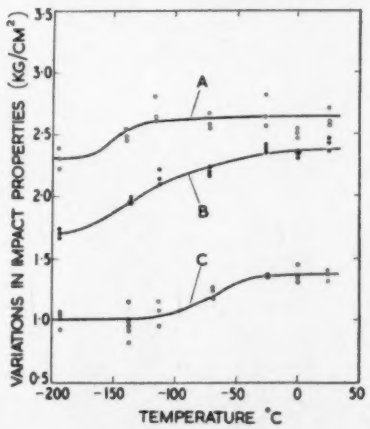
Below right: Fig. 17—Avional 24, naturally aged Avional 24 and fully heat-treated Ergal 55

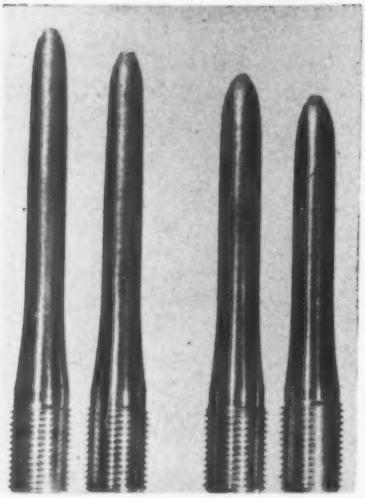
A—Annealed Avional 24. B—Naturally aged Avional 24. C—Fully heat-treated Ergal 55



Impact Test Results

Impact tests, the results of which are illustrated in Figs. 14-17, were usually carried out in triplicate but in some instances a greater number of tests was necessary. The results obtained from annealed commercially pure aluminium have not been reported because the specimens did not break but bent at positions away from the notch. Perhaps by using a deeper notch, such as for example that of the Charpy test piece, bending would have been avoided, but for the sake of uniformity with the other alloys and with the Italian standard it was considered undesirable to introduce another variable into the present investigation. Specimens of annealed Peraluman 35 and hard commercially pure aluminium also deformed without





fracturing but bending at positions away from the notch did not occur. The values reported in the diagrams therefore should merely be considered as indications of the work absorbed. The curves obtained were of three different typical shapes:

(a) In which impact values progressively increased as temperature decreased, as, for example, hard commercially pure aluminium.

(b) In which a maximum was obtained, for example, the curve for Peraluman 35 had a maximum in the region of −40°C. and that for Anticorodal 11 had a maximum in the region of −80°C.

(c) In which impact values decreased with temperature in a way similar to that encountered in ferrous alloys but to a lesser extent.

A test above room temperature at 55°C. was conducted on hard Peraluman 35 in order to confirm the slope of the curve indicated by the results of the low temperature tests.

Examination of Fractures

In order to complete the investigation, the fractures of the tensile test piece, Figs. 18-23, were examined. Typical fractures obtained for hard commercially pure aluminium at two temperatures and for annealed Peraluman 35 at each test temperature are illustrated in Figs. 18 and 19 respec-

Left: Fig. 18—Appearance of test pieces of hard commercially pure aluminium tested at —195°C and room temperature respectively

Below: Fig. 19—Appearance of the fractures of tensile specimens of annealed Peraluman 35 tested at different temperatures

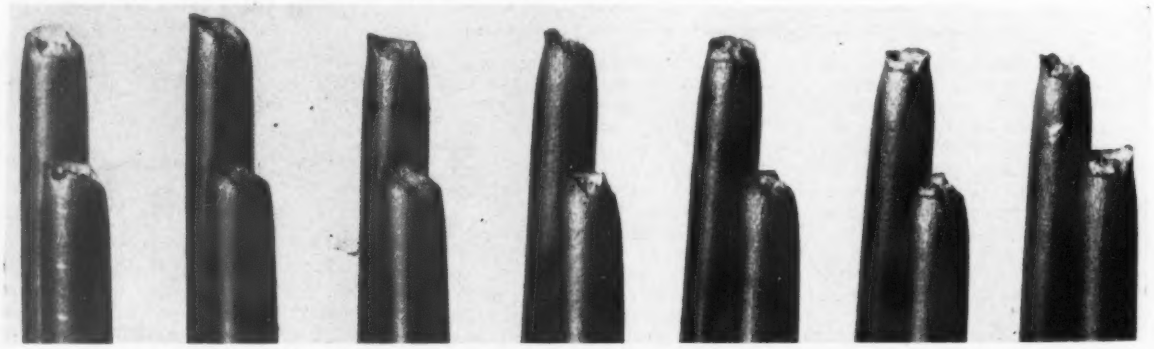


Fig. 20—Appearance of the fractures of tensile specimens of annealed Avional 24 tested at different temperatures

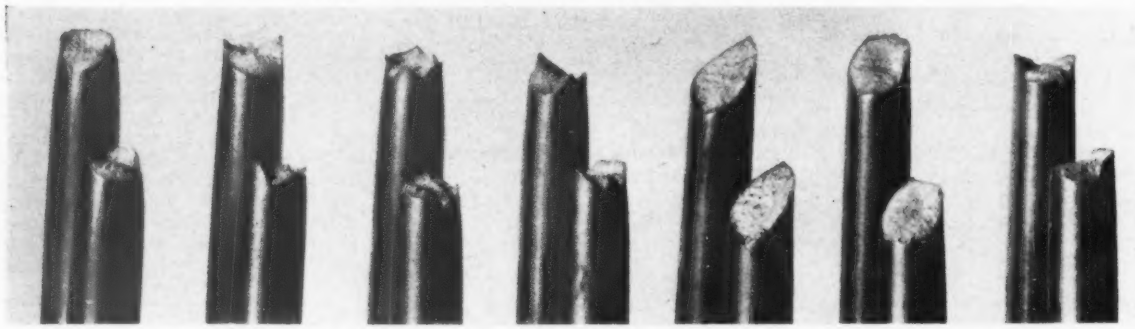
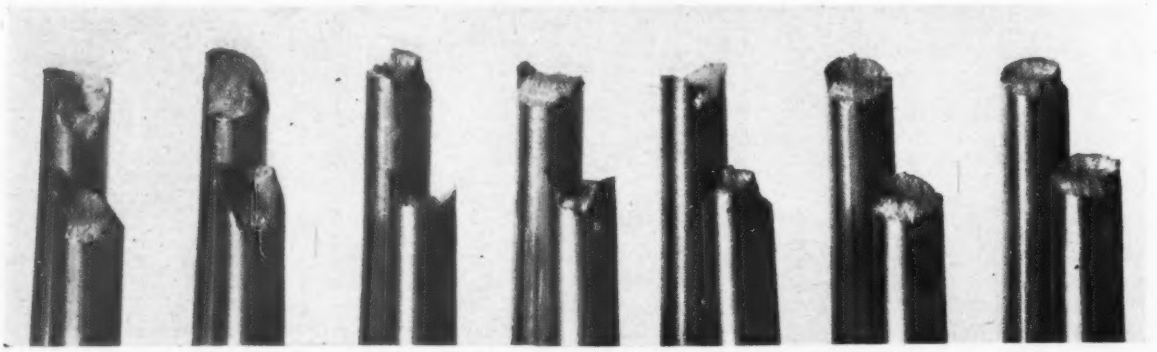


Fig. 21—Appearance of the fractures of tensile specimens of naturally-aged Avional 24 tested at different temperatures



tively. The fractures in commercially pure aluminium did not vary with test temperature but there was a marked increase in elongation with decrease in temperature. Fractures in annealed Peraluman 35 varied slightly, reduction in area decreasing with temperature.

Progressive differences with decrease in temperature were not observed in the fractures of the heat-treatable alloys but in some instances, for example, room temperature aged Avional 24, it was possible to pick out typical fractures for each particular temperature. Fractures in fully heat-treated Anticorodal 11 were of the type illustrated in Fig. 22 for all temperatures whilst the fractures depicted in Fig. 23 are typical of those of fully heat-treated Ergal 55 also over the whole range of temperatures examined.

Before terminating the discussion of results it is necessary to describe the stress-strain curves obtained for soft Peraluman 35. The curves determined at room temperature had discontinuities characteristic of local yielding, this behaviour being connected with strain-ageing. As the temperature decreased the discontinuities decreased in intensity until at temperatures below −25°C. they completely disappeared, because of the reduction in the ease with which the magnesium atoms associated with dislocations caused by the tensile stress, could move.

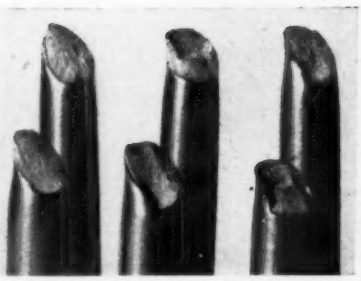


Fig. 22—Appearance of the fractures of tensile specimens of fully heat-treated Anticorodal 11 tested at room temperature, —70°C and —195°C

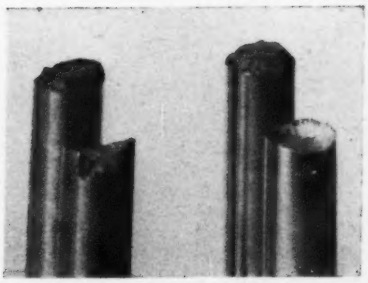


Fig. 23—Appearance of the fractures of tensile specimens of fully heat-treated Ergal 55 tested at —195°C and at room temperature

Conclusions

It may be concluded from the results obtained from the determination of mechanical properties at subnormal temperatures that:

(a) As test temperature decreases the ultimate tensile stress of all the alloys tested increases.

(b) For all the alloys 0·2 per cent proof stress also increases but the increase is particularly marked for the heat-treatable alloys in the heat-treated condition.

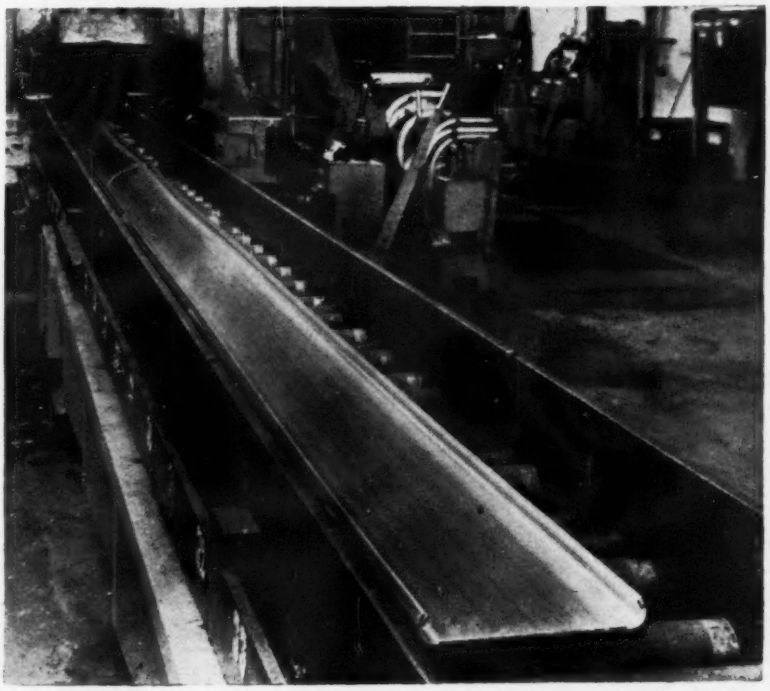
(c) Elongation increases markedly in alloys which are not in the heat-treated condition but decreases, often only slightly, in the heat-treated alloys.

(d) There is a progressive increase in impact properties of hard commercially pure aluminium whilst for fully heat-treated Anticorodal 11 and both hard and annealed Peraluman 35 maxima occur at temperatures between 0°C. and −100°C. Impact properties decrease slightly with temperature for annealed Avional 24 and naturally aged Avional 24 and for fully heat-treated Ergal 55.

Fabricating Tapered Lighting Columns

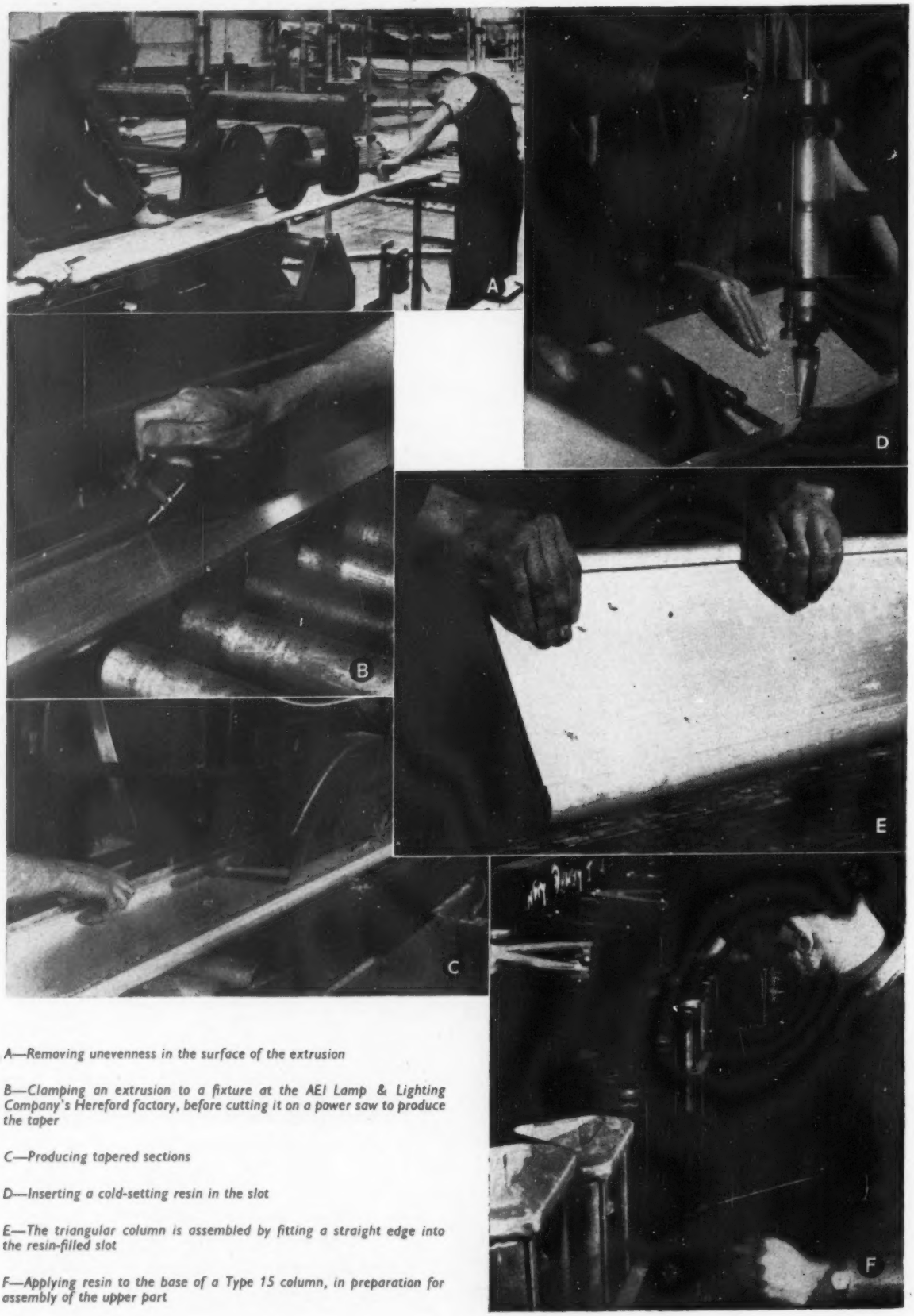
IN 1956 the AEI Lamp & Lighting Co. Ltd. began to think in terms of an aluminium street-lighting column, but the amount of welding required on rolled tube made this type of construction expensive. In the following year, however, Reynolds-T.I. Aluminium offered the company extrusions in aluminium alloy, and it was decided to use an extrusion instead of tube. Aluminium had earlier been used in the U.S.A. for street-lighting columns, but chiefly in the form of hot spun sections.

The first product of the collaboration between Reynolds-T.I. and the AEI Lamp & Lighting Co. Ltd. was a triangular 15 ft. column, the "Leader". Three versions are available—the Type 15, 15 R, and 15 T; the type 15 R is of circular section, the other two are of triangular section, and only the latter will be dealt with here. The alloy (RTI 441-EP) contains about 1 per cent silicon and 0·7 per cent magnesium. It is aged after extrusion, and after ageing its mechanical properties are as follows—0·1 per cent proof stress, 10 tons/in²; ultimate tensile strength, 12 tons/in²; elongation, 12 per cent on 2 in. gauge length.



Extrusion coming off the 5,000 ton extrusion press at Reynolds-T.I. Aluminium's Tyseley works. Note the slotted edges

Tests of complete columns have shown that the "Leader" will withstand up to four times the maximum load likely to be encountered in normal conditions. Compared with conventional street-lighting columns, the "Leader" is distinguished by the absence of welding. The three extrusions are bonded by a cold-setting epoxy resin, and 24 hr. after assembly



A—Removing unevenness in the surface of the extrusion

B—Clamping an extrusion to a fixture at the AEI Lamp & Lighting Company's Hereford factory, before cutting it on a power saw to produce the taper

C—Producing tapered sections

D—Inserting a cold-setting resin in the slot

E—The triangular column is assembled by fitting a straight edge into the resin-filled slot

F—Applying resin to the base of a Type 15 column, in preparation for assembly of the upper part

(the "curing" period of the resin), the column is ready for the addition of the spigot, bracket, and lantern.

The extrusion which forms the starting point of manufacture is a long panel with curved and slotted edges, produced on a 5,000 ton Loewy press at Reynolds-T.I. Aluminium's Tyseley works. The billet is heated for some 12 hr. at 500°C. before being loaded into the press, and extrusion takes place at a rate of 12 ft/min. After cooling, the extrusion is stretched and straightened.

To produce the characteristic taper of the 15 ft. column, it is clamped to a fixture on a gravity conveyor and cut by a power saw. The aperture for the door at the base is cut on a Wadkin routing machine. The slot is filled with synthetic resin by means of an instrument similar to a grease gun, and the sections are assembled by fitting the straight edge of each into the slot of the adjoining section. The assembly is then left for 24 hr., and the process is completed by bolting the spigot cap (a sand casting) to the top. All that remains is to add the bracket and lantern.

One version of the column, the Type 15, is in two parts, and synthetic resin is used to bond the upper portion to the base.

Except for tack welding, to give additional strength, this process therefore eliminates the necessity for welding. In time, oxidation causes a white deposit to form on the surface of the column, but experience shows that weathering is slight, and the surface film actually protects the metal beneath. Painting may, however, be necessary under the most severe conditions. The root of the column is protected by the application of cold-dip (or, if necessary, hot-dip) bitumen paint.

Assembling a Type 15 column in a vertical fixture

This first design was introduced to street-lighting engineers by the AEI Lamp & Lighting Co. Ltd. at the conference of the Association of Public Lighting Engineers in the autumn of last year, and the interest shown by local authorities has already justified its production. New designs are accordingly being prepared.

Research in Welding

A NEW method for the autogenous welding of copper, a torch for the fine wire welding of thin aluminium sheet, and work on the fatigue strengths of titanium and Nimonic alloys were among the research work shown to industry and the press at the recent open day of the British Welding Research Association. The principal guest on this occasion was Sir Alexander Fleck, K.B.E., F.R.S., who referred to the diversity of industries dependent upon welding research, and expressed the view that the contribution to the work of the Association that was received from some quarters in industry might well be greater.

Work of interest to the non-ferrous metals industry included studies of the fatigue properties of various types of welded joints in aluminium, titanium and Nimonic alloys. The welding of thin aluminium sheet has been facilitated by a gun for use with the inert-gas metal arc process which uses a wire of $\frac{1}{16}$ in. thickness. In copper welding it has been found that the use of cap copper with a zinc content of up to 3 per cent enables autogenous welds to be made, a process that may have a promising field of application in domestic hot water systems. Welding conditions for tough-pitch copper are also being defined.

In aluminium-bronze, cracking and embrittlement have been studied, and there have also been studies of a number of problems in the welding of dissimilar metals. Resistance welding work has included research into the possibilities of ultrasonic welding, a technique that permits low pressures and temperatures to be used and gives negligible distortion; this appears to have applications for the welding of thin foils and for joining very thin sheet to thick plate.

Work in the resistance welding laboratory has also included the sealing of thermocouples to Magnox fuel cans for atomic energy work.

Two new extensions to the existing laboratory facilities are being built.

Obituary

Mr. M. Hay

IT is with regret that we record the sudden death, on June 30 last, of Mr. Matthew Hay, for many years secretary to the Scottish Section of the Institute of Metals. Mr. Hay, who was well known in the engineering world, had been associated with A. Cohen and Co. Ltd. for twenty years.

Mr. E. J. Jordan

WE regret to record the death of Mr. E. J. Jordan, a former District Engineer of British Insulated Callender's Construction Company Ltd. He had been with the company for 36 years prior to his retirement.

Mr. J. G. Kay

IT is with regret we also record the death of Mr. John Goodrich Kay, chairman of Lafarge Aluminous Cement Co. Ltd. Mr. Kay had been a director of the company since its inception in 1923 and chairman since 1948.

Mr. A. H. Wilson

WE also regret to record the death of Mr. Archibald Hammond Wilson, managing director of Evered and Co. Ltd. of Smethwick. Born in 1904, and educated at Oundle, Mr. Wilson joined Evered & Co. Ltd. in 1923.

He was appointed a director in 1929, in charge of the Brassfoundry Department, and was responsible for the Company's entry into the plastics industry. He was appointed managing director in 1947.

Mr. Wilson was a member of the Council of the National Brassfoundry Association for many years—being President in the Diamond Jubilee Year 1957. He was also a member of the Executive Council of the Royal Metal Trades Pension and Benevolent Association, and had been chairman of the Midland Area Council.

Products and Processes

TRENDS IN THE DEVELOPMENT, APPLICATION, PROCESSING, DESIGN AND WORKING OF NON-FERROUS METALS AND THEIR PRODUCTS

Sand Moulding Without Water

A SAND-BONDING agent which relies on a chain of hydrocarbons to make bonding possible in the presence of oil enables moulds to be made entirely without the use of water. The moulding sand is mixed to the following recommended composition: 100 lb. Redhill sand (HH, H or silica sand of similar grain), 4 lb. "Petro-Bond" special sand binder, 3 lb. oil, ½ lb. methyl ethyl or isopropyl alcohol. After mixing, these ingredients give a good green strength, and the sand may be used either as a facing sand or the moulding box may be filled entirely with the mixture. The latter method ensures recovery of the unburnt sand, which is immediately ready for re-use without further processing for a number of castings. Eventually added strength will be needed, and remilling with a small addition of "Petro-Bond" will be necessary.

Advantages claimed for this material, which is a product of F. W. Berk and Co. Ltd., are: finer mould and casting finish, longer sand life without re-milling, and absence of water permits low permeability without generation of gases.

Pattern and Die Making

EPOXY resins, especially those with the strength and resilience needed for making press tools, jigs, moulds and fixtures, have enabled conventional methods of tool and pattern making involving elaborate, lengthy metal work to be dispensed with in many instances.

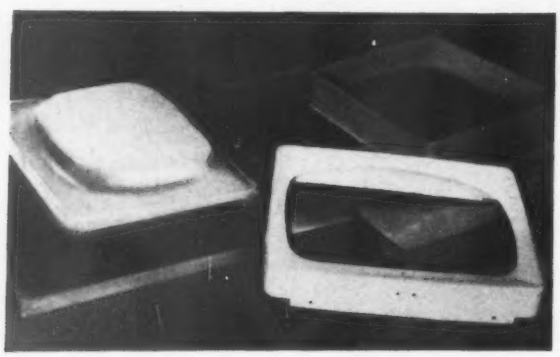
Plastics tools have none of the fragility often associated with the use of plastics, and they may often be used for heavy duty. The materials, nevertheless, are usually much lighter than metal, an important point when large tools are involved. When frequent design changes must be made, and, above all, in the smaller factory or for the individual experimenter, the advantages of being able to mould tools are self-evident. When small alterations are involved, plastics are easier to work than metals.

The process of making a plastics tool normally involves coating the mould or moulds with a release agent, before applying the face compound, after which the main core mix is poured. The techniques of casting or moulding have thus partly replaced machinery, but may bring problems of their own, particularly when a satisfactory "pour" must be ensured. Mould and pattern making, of course, involve problems, but they are more tractable than those often involved in metal machining.

Plastics tooling in general, and "Double-Bond Toolform" in particular, is especially suitable for press tools for making the moulds used in vacuum forming, and for foundry patterns.

Plastics resins can be modified by many additives for special purposes, as, for instance, dry lubricants in the facing of models subject to high wear. Abrasion resistance is also of value in foundry pattern work, where plastics tooling has many applications. Also, an excellent marriage of metal and plastics can be arranged by the use of metal inserts which can be easily positioned prior to pouring the Toolform compound, a product of the Kenilworth Manufacturing Co. Ltd.

Below: Male and female press tools for a 14 in. TV mask in aluminium. The tools are made from Double Bond Toolform

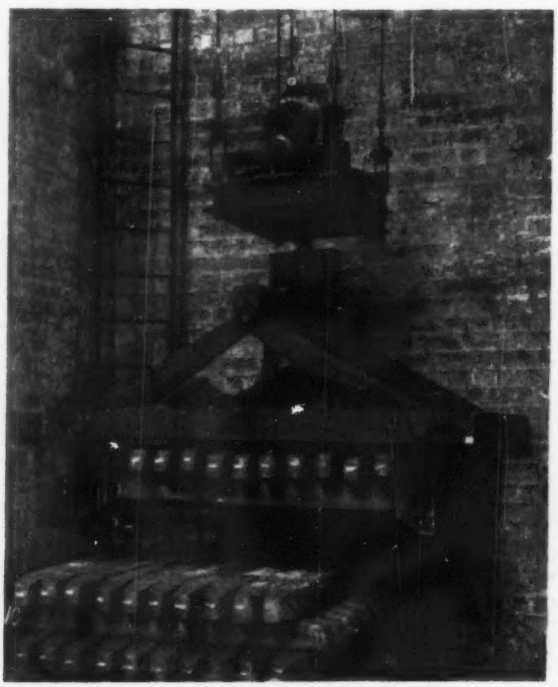


Handling Copper Wirebar

IN the handling of copper wirebar at the Manchester works of Richard Johnson and Nephew Ltd., considerable expense was involved in dock dues chargeable during the time taken to off-load from the dock into the works stock bay. The wirebar is stacked in 1½ ton layers, with each layer at right angles to the next, and Somers automatic patent tongs are used to lift and load the metal. Although this could be done entirely by control from the crane cab, it was still necessary to have manual attendance at ground level, to guide the tongs to the right angle, and then, when the load was transferred to the stock-bay, which is extensive, to wait until the slinger could get across from one point to the other, in order to control the lowering of the load at the correct angle, again, on to the stack. This operation was also repeated in reverse when the stock was transferred to the furnace-feed adjacent.

A turntable device has been designed by Walter Somers (Material Handling) Ltd. which, built over the tongs and controlled by powered cable from the cab, turns the tongs 90° either way. Pivoting was overcome by four wires attached one at each corner of the turning-gear frame, and controlled by self-winding reels attached to the travelling carriage of the crane.

Right: Lifting double layers of copper wirebar with the turntable device on Somers automatic patent tongs. Control is entirely from the crane cab



A further refinement has been introduced by which the jaws of the tongs are built with a double lip, with a selector mechanism incorporated in the controls so that either a single or a double layer can be picked up at will.

Handling speeds have been considerably improved by these two adaptations. Under normal working conditions, a lorry bearing an eight-ton load can be off-loaded and the stock correctly stacked into stock-bay within 4 min. of the lorry being driven on the weighbridge, the work being completely handled and controlled by the crane driver.

Drawings Replace Templates in Torch Cutting

SIMPLE pencil line sketches of intricate shapes and forms can be used to guide oxygen shape-cutting machines, as a result of a new electronic tracer introduced by the Linde Department, Union Carbide International Company, Division of Union Carbide Corporation. A built-in automatic kerf compensator makes it possible to reproduce one or thousands of complicated metal parts easily and with extreme accuracy from exact size drawings.

The Linde photocell tracer eliminates the need for expensive metal or plastics templates, photographic negatives, or complicated and costly silhouettes. Drawings of parts are made to the exact size of the part desired. The kerf compensator dial is then set for the plate thickness being cut and automatically compensates for kerf width so that reproduced parts are exactly the same size as the line drawing.

Tracing accuracy is excellent and intricate metal shapes and small holes that cannot be cut using present mechanical-type tracing heads, can be cut readily with the new Linde photocell tracer. It is not sensitive to extraneous light and will not follow shadows so that shape-cutting can be done anywhere regardless of lighting conditions. Tracing speed is controlled by an efficient eddy-current governor which provides smooth, stepless speed control over a speed range adjustable from 2 to 30 in/min. At average cutting speeds, the tracer can negotiate 90° turns with $\frac{1}{16}$ in. radius.

With the new tracer it is possible to use line drawings that will make the cutting torches move from one series of cut shapes to another, without interruption, for "chain" cutting. Manual operation is also provided.

Extruded and Drawn Bearing Metal

NOW available in the form of bar and tube in the extruded and drawn condition, Alzen 305 bearing alloy has many advantages in this form, the main ones being: (a) the superior physical properties, in particular the increased ductility; (b) the closer dimensional tolerances obtainable compared with conventional chill cast solid and cored bar; and (c) the surface finish of both the outside diameter and, in the case of tubing, the bore.

To elaborate this point, the physical properties of Alzen 305 are as follows:—0·1 per cent Proof Stress—15 tons/in^2 min. Ultimate Tensile Stress—25 tons/in^2 min. Elongation per cent—12 min. Modulus of Elasticity—11×10^6. Brinell Hardness—100-150.

The dimensional tolerances of both bar and tubing in the extruded and drawn state are similar to those obtainable with extruded and drawn aluminium and its alloys. Certain modifications have been made to the upper and lower limits of outside and inside diameters in order to accommodate the material for the machining of bushes, particularly in respect of lower limits not being less than the nominal diameter in the case of the outside and not being greater than the nominal diameter in the case of the bore. It will be appreciated, of course, that the eccentricity value normally associated with all extruded and drawn products is also present in Alzen 305 to the same degree as with the aluminium alloys.

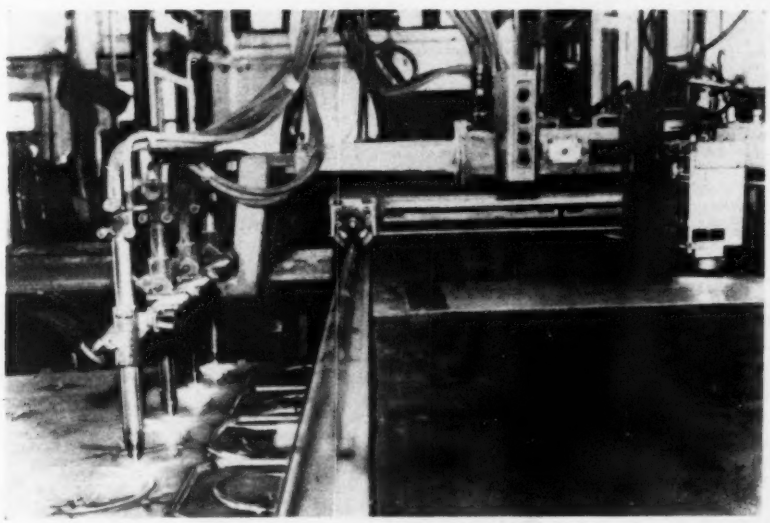
This material is being processed in this country in the extruded and drawn state by Reynolds T.I. Aluminium Ltd., and is being marketed by the sub-licensees, Hill, Alzen (Sales) Ltd.

Brass Metal Powder Parts Cut Costs

AN example of the advantages found in designing parts to be made by powder metallurgy is given by two brass powder parts—the conventional adjusting nut and lock sleeve used to regulate the handle adjustment on the Halsey Taylor Drinking Fountain Valve. Both were formerly made from brass stock on a screw machine. The adjusting nut was cut from brass pinion stock while the lock sleeve was cut and shaped from a solid bar. Both pieces were considerably more expensive in machine time, labour cost and scrap material (plus inventory, storage and handling costs) than the identical part formed and sintered with brass powder. Tapping the thread in the adjusting nut is the only secondary operation required on either part.

In assembly, the adjusting nut is turned down, finger tight, on the threaded section of the valve stem to prevent excess handle movement. The lock sleeve holds the adjusting nut in place by engaging two opposing teeth of the nut. The slotted hole in the top fits over the flat sides of the valve stem to lock the adjustment. Once in place, both adjusting parts are concealed (yet remain readily accessible) by the plated cap.

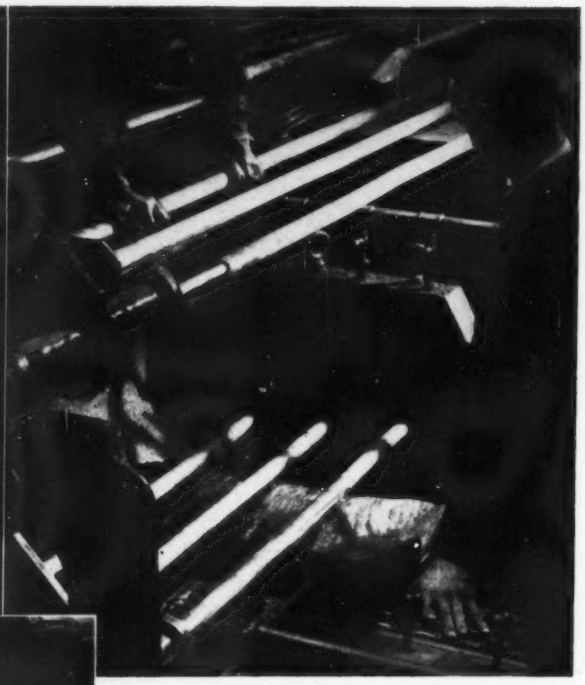
This type of valve allows water flow only while the handle is held in an open (turned) position. It shuts off automatically when released, allowing the handle to roll back into its normal position.



Left: The Linde photocell tracer in use on an Oxweld CM-15 cutting machine

Below: Adjusting nut and lock sleeve made from brass metal powder

Metalworking Anniversary



Top left: Casting copper billets at the works of Evered and Co. Ltd.

Top right: Tube drawing

Left: In the rolling mill

Below: Slitting brass strip

IT is 150 years since Richard Evered started up as a brass caster in Charles Street, off Long Acre, London, and in 1866 the business moved to Surrey Works in Smethwick. The firm's early growth coincided with the establishment of gas and water authorities, and in the engineering division, fittings for these services form an important part of their production. More than 60 per cent of all the gas and water governors used are made by Evereds, and in the laboratories, research, experiments and tests are always in hand to further their efficiency. Laboratory fittings in great variety are also manufactured in this division, as well as suites of taps for domestic use.

In the rolling mill, brass, copper and phosphor bronze strip is produced from the billet to the finished strip, and supplied for a wide variety of industries. In the tube mill, brass and copper tube is drawn to a multitude of shapes and sizes. Radar tube to extremely fine limits is also produced in this mill.

An interesting connection between the early days of the firm and the present time is a by-product of tube production—brass bedsteads. A current fashion has revived the demand for brass bedsteads, and Evered's own designers are producing a variety of models, using both square and round section tube.

Design of Die-Castings

XI—Structural Elements and Frames

By H. K. BARTON

IN the design of most die-cast articles the question of structural strength is not raised as a separate issue, either because the component will not be greatly stressed in service or—most often—because it is obvious that die-castings designed in accordance with other more immediate criteria—ease of production, freedom from distortion during removal from the die, and so on—will have a margin of strength to meet normal service hazards and accidental overstresses. Moreover, in the majority of cases the designer is comfortably aware that, should any locus of weakness be apparent in the sample castings when they are tested, there is ample scope for ribbing or stiffening up the section to meet virtually any strength requirements that may prove necessary.

That this is so may readily be seen by considering small load-bearing structures in domestic equipment and similar applications. As an example one may take a simple gear-housing, which functions merely as a rigid frame holding a set of shaft bearings in a prescribed orientation. Such a part might well be produced as a sand-casting along the lines indicated in Fig. 1, with thin sheet-metal covers to enclose the mechanism and exclude dust.

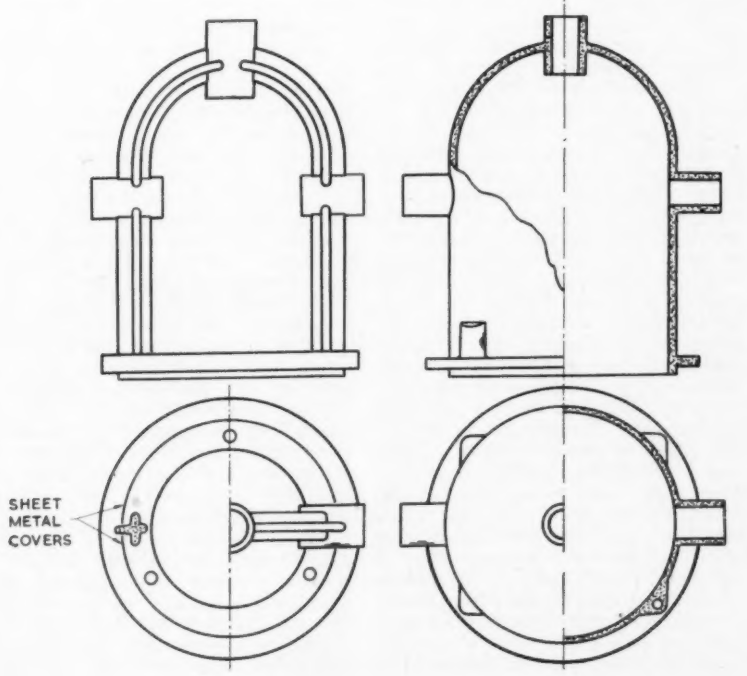
Structurally the housing is quite satisfactory, and one might conceivably replace it just as it stands by an identical die-cast frame (thereby gaining some advantages such as reduced machining and easier assembly) and still fit the sheet-metal shells. However, the possibilities of die-casting are now so well appreciated that most designers would not really give much thought to such a part-for-part changeover, but would pass straight on to the more effective design sketched in Fig. 2, where the die-casting combines the properties of both the frame and the thin sheet covers.

The die-casting is much simpler in its essentials than the assembly of Fig. 1; in fact, it is simpler than a die-cast replica of the frame alone. This latter would have to be cast with its cruciform sections in the plane of the die parting, which would entail the use of opposed core slides to form the two lateral bosses and of a stepped core to form the large bottom opening and the bore of the top blind boss. As against this, the one-piece shell of the design in Fig. 2 allows the lateral bosses to be formed by fixed cores at right angles to the die parting, a single massive core then forming the whole interior surface of the component.

The die-cast shell is, of course, much thicker than the original dustcovers and, as may be assessed from the sectional views, the total annular area of the shell greatly exceeds that of the stress-carrying cruciform sections of the frame. Unless, therefore, the die-cast component is going to encounter forces and shocks to which the assembly was not previously subjected, there is no need at all for any additional stiffening of the structure. However, this comment refers only to the individual case discussed above, and it might quite easily happen that a housing of identical form and function would be required to withstand so much abuse that some local augmentation of the structural strength would be desirable.

Some of the ways in which a basic shell-like casting of this type may be progressively stiffened up to improve the load-carrying, or stress-resisting, properties may, therefore, be considered. Looking again at the section of Fig. 2, it will be evident that under axial pressure the dome of the component can yield without other distortion occurring—without, that is, the stresses generated being communicated to other portions of the die-casting. Again, the inner ends of the axial bosses are not supported against forces acting radially inward.

With regard to these two possible thrusts, it is true that the first (Fig. 3) is unlikely to be encountered in normal

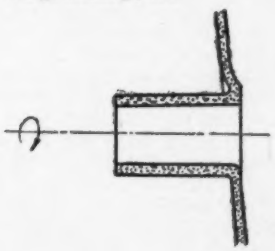


Extreme left: Fig. 1—A cast-iron frame for a gear assembly; two sheet metal covers protect the gears in service

Left: Fig. 2—A dome-shaped die-casting of identical function embodies both structural and protective elements

Fig. 3—Distortion (left) or fracture may occur if a boss is subject to excessive end-thrust

Fig. 4—Distortion, much exaggerated, resulting from a large cranking force



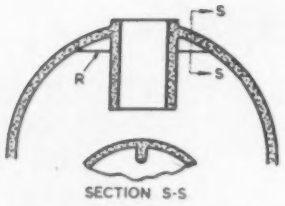


Fig. 5—Even small ribs greatly increase the resistance to axial distortion

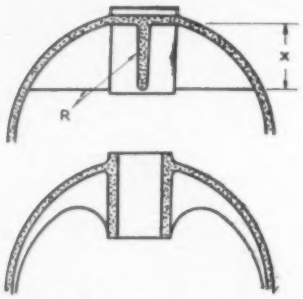


Fig. 6—Ribs formed by deeply slotting the core (top) are less satisfactory than the arcuate ribs below

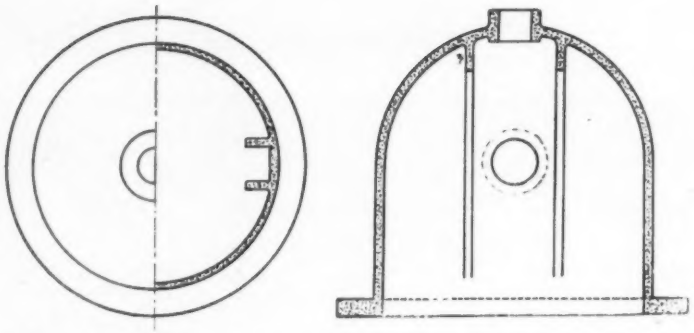


Fig. 7—Parallel ribs form a slot to locate a sub-assembly (left); they may be extended to form an internal arch as on the right

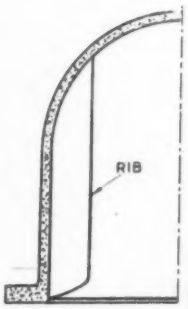


Fig. 8—Radial ribs continuing to the base are of little advantage unless they are required as means of attachment for a sub-assembly

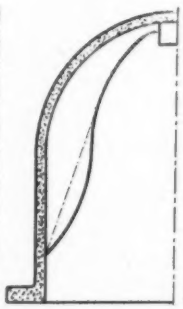


Fig. 9—The curved rib stiffens the dome, but nothing would be lost in rigidity if it were brought off along the broken line

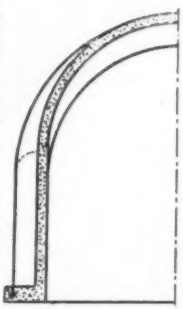


Fig. 10—The portion of the external rib above the broken line has little more than decorative value

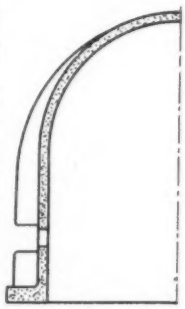


Fig. 11—Interrupted ribs, common in sandcastings, are only practicable on diecast components at specific locations in the die

service, but the top of a dome—especially if carrying a projecting boss—may well suffer heavy accidental impacts. As for the second, one may consider cases where the boss is cored right through and forms a bearing for, say, a hand-crank. The lateral forces then set up tend to displace the axis of the boss and rotate it, as indicated in Fig. 4. Crank motion may, of course, also have an appreciable component of inward axial thrust. Even in regard to the radial stresses, however, it is important that the assembly should withstand the shock loads of accidental blows on the projecting end of the crank; if this latter has a long arm and is itself rigid (mincing machines and the like), blows of this sort can permanently strain an inadequately-supported bearing boss.

Axial thrust is readily spread over a greater area of the load-bearing cross section, and its flexural element diminished, by slotting the end of the core to form cavities for radial ribs connecting the boss with the shell. If the ribs are short and straight (Fig. 5), axial thrust can still result in collapse at the rib ends, though under much heavier loading than in the unribbed component, but by bringing the ribs down toward the cylindrical portion of the shell the load is almost completely a compressive one.

The further down the boss the ribs are brought, the better is the resistance to unsymmetrical loading of the sort indicated in Fig. 4, so that one might be tempted to use ribs of the form shown in Fig. 6, top sketch. These are very deep in the direction of stripping (a point at the bottom of the rib has to drag across the cavity surface for the distance x as the die is opened) and this is conducive neither to strength nor speed of production. It is accordingly preferable to retain the long junctions of the rib with boss and shell, but to reduce the stripping distance by adopting an arcuate rib profile on the lines of that depicted in the lower sketch of Fig. 6.

Although radial ribs are most general, since it is normally necessary to guard against stresses from all angles, there is no reason why, even in a dome-shaped component, stiffening ribs with other orientations should not be used. The only variant that occurs with any frequency, however, is the pairing of ribs seen in Fig. 7. Usually the adoption of such dispositions is not primarily determined by strength requirements so much as by assembly needs; e.g., the channel between the ribs may provide a housing for some sub-assembly. Nevertheless, a pair of ribs spaced well away from the central boss, and crossing the interior of the dome from one lateral boss to the other, could be of use when, due to the reactive force of the mechanical elements within the housing, there is an outward thrust axial to the central boss. These, seen on the right, provide a structure similar to but stronger than that of Fig. 2.

Internal ribbing may be restricted to the deeper parts of a recessed component or may be extended back toward the rear face, and provided that no undercuts are formed, may be varied considerably in depth and form as may be seen in Figs. 8, 9 and 10. The scope for ribs running from the rear face inward is more limited. At most, their inner edges can only be parallel with the axis of the component (this being the direction of stripping), and preferably they should be slightly inclined to it. Since the outer shell, too, must have a small taper to facilitate ejection, an interior rib running from the base must normally be of substantially constant height and unbroken profile. Only if the shell of the component has a very marked taper indeed can the rib run out to nothing on the side-wall; more often it must be continued to the farther end of the recess.

This, however, is not always desirable (it may impede the location, or impair the operation, of the internal mechanism) and it may accordingly be preferable to leave the interior completely free from projections. Such stiffening ribs as are called for may then be disposed externally, and there is not in this case any reason why they should not stop short partway up the wall as indicated by broken line in Fig. 10. Whether they may also be interrupted (Fig. 11) depends upon the

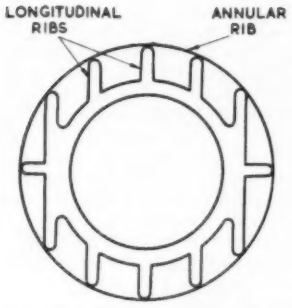


Fig. 12—Here circumferential and annular ribs are combined to give a cellular structure capable of withstanding high bursting stresses

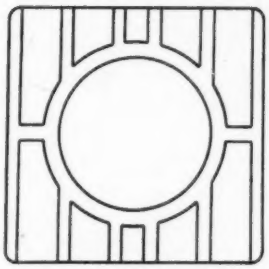


Fig. 13—A less unattractive alternative to the previous figure

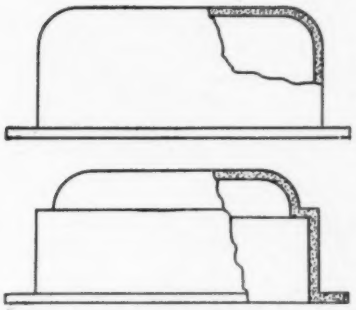


Fig. 14—The flange of the upper casting serves to stiffen it against stresses inducing ellipticity; the resistance is much greater in the lower design, with a shoulder immediately below the dome

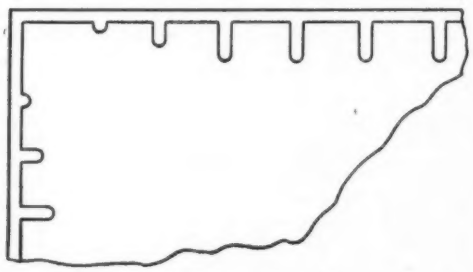


Fig. 15—Internal ribs should be kept well away from the corners of rectangular box-like components since they result in local over-heating

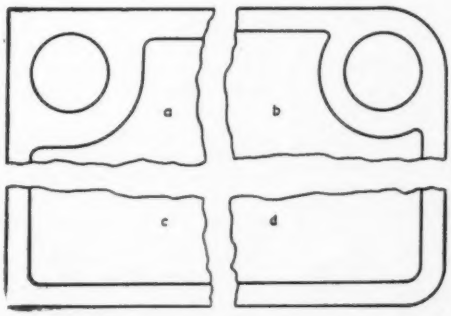


Fig. 16—Corners of box-like components, cored and uncored: those at b and d are to be preferred

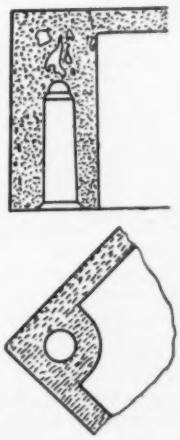


Fig. 17—Porosity beyond a cored hole

orientation of the casting in the die; if the outer surface is formed wholly within one die member, the ribs cannot be anywhere re-entrant. Where the cavity is split between the two die members, by contrast, the ribs may be re-entrant to any extent but only where they lie either on, or exactly normal to, the parting-plane can they be disposed radially to the axis of the cavity.

In this last instance it is possible to use circumferential ribs instead of, or in addition to, the transverse ones. The cellular structure resulting from their combination has great strength, but is intolerably ugly—see the cross section of Fig. 12—and is really only justifiable when there are very large bursting stresses, as in oil-hydraulic systems, jack bodies and the like. And even in such applications the appearance of the part would be improved by adopting a squared-up construction like that of Fig. 13.

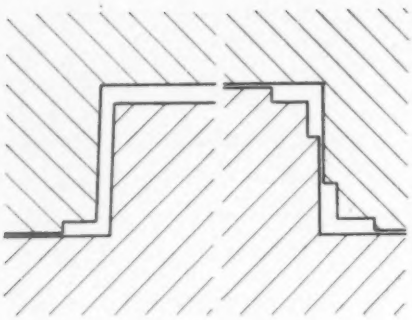
Transverse thrust—as, for example, between the opposed lateral bosses of the component in Fig. 2—can also be countered by annular external ribs where these are castable, but there are other ways of preventing the circular cross-section from distorting into ellipticity. The housing may be stepped at critical places as in Fig. 14, the shoulder being even more effective than a rib of the same width in preventing distortion. It is not essential that the rib should be of constant breadth; that is, advantage can be taken of a change of cross-section to add transverse strength to the component. Unless the part is to be polished and plated, this course is as acceptable as the usual method of "fairing" one contour into the other.

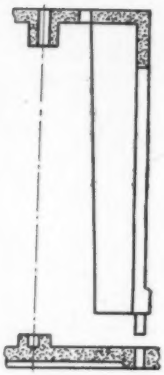
When a component is shouldered in this way, the portions above or below the step may be differentially strengthened by the use of ribs. In the lower part of the component these are formed internally and run up into the shoulder; if the upper part is to be strengthened the ribs spring from the external shoulder. In either case the combination of shoulder and rib greatly strengthens the housing against thrust from any direction.

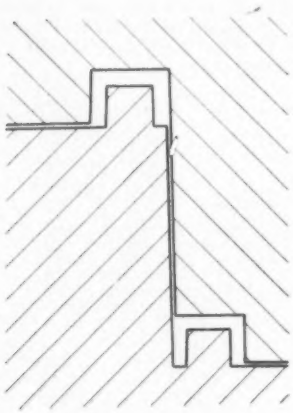
Although for simplicity of description all the features discussed above have been depicted in the figures as applied to housings of circular outline, they can, of course, be equally well used when the casting is of rectilinear, or of irregular, plan. In the former case, that is, in housings of a box-like character, the angles are themselves features conducive to rigidity. Ribs should, therefore, not be located too near to the corners, especially to the internal corners since the rib cavities then tend to isolate thermally the corners of the core. It is often possible with advantage to graduate the projection of ribs in such situations (Fig. 15), keeping them high in the middle of the wall and reducing them to nothing as the corner is approached.

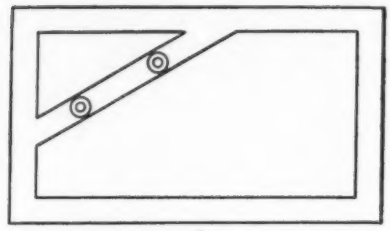
The corners of die-cast components can be as sharp as desired, but unless there are functional reasons for a sharp corner it is better to allow a radius both externally and internally. In a monobloc cavity member produced by milling, the natural radius of a corner —external, on the casting—is the radius of the cutting tool. All non-critical external radii should therefore be marked on the part drawing:— "Rad. to suit milling cutter: Max. $1/x$ diameter." The conforming internal radius will be chosen by the toolmaker so that there is no change of section thickness at the corner.

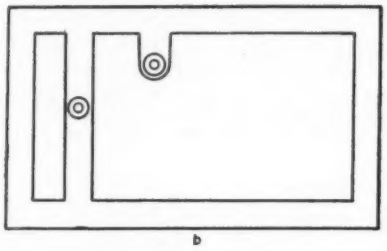
Small rectilinear die-castings are sometimes produced with square external corners and re-entrant internal ones (Fig. 16a) producing a locally-increased section that can be cored out for a tapping hole. Unless the component is a shallow one, this leaves a heavy section beyond the core tip and this, at the junction of three faces, is particularly well adapted to attract air inclusions. This is not particularly troublesome on small components, where the air is generally trapped completely within the section (Fig. 17), but if the cross-section becomes large enough to contain a $\frac{1}{16}$ in. diameter circle—or thereabouts—there seems to be a tendency for the air to be trapped against the inner face and so give rise to visible faults.

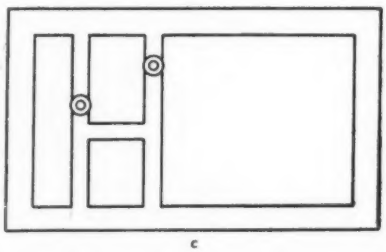












Top left: Fig. 18—Position of the main die blocks when producing a box (left) and an open frame

Left: Fig. 19—Producing an open frame of channel section

Above: Fig. 20—Two die-castings assembled by integral rivets, as here, are often easier to cast than a complex frame

Right: Fig. 21—Support strips for bosses; the layout at c indicates the lines that should normally be followed. Note that the cross-brace is positioned away from both bosses

Even these seldom affect the utility of the casting, and in U.S. practice the buyer normally accepts such components provided that the imperfection is reasonably shallow. However, by adopting a design free from sudden section changes all faults of this sort can be virtually eliminated. Many alternative constructions are possible; the component may be flanged, provided with short external buttresses, or the fixing holes may be moved away from the edge altogether.

From box-like components consideration may be given to die-castings forming open frames in either two or three dimensions. By and large, the same restrictions that are imposed upon components of unbroken surface apply to open frames of comparable shape and orientation within the die. Indeed, from the die-caster's—or rather the die designer's—viewpoint, there is little fundamental distinction between open and closed structures. As the tool sections of Fig. 18 show, the open frame is formed in exactly the same way as the box, but the space between the two die members is reduced to zero over large areas of the sides and bottom.

The requirements for external and internal draft, to facilitate stripping and ejection, are accordingly much the same in both classes: in practice, it is desirable to provide more generous tapers in the case of open structures, since galling of the core and die surfaces is much more probable when they are in direct rubbing contact. The location of the various frame elements in the die determines the scope for varying their shape; as the sketch on the right of Fig. 18 shows, the most obvious and simple section to adopt is a right-angled one turned inward at the top and outward at the base.

This gives adequate strength in the majority of applications, but it is possible without unduly complicating the tool to produce channel sections at the top and base (Fig. 19) though the lower channel must, of course, always be offset from the upper channel in the manner illustrated. If for any reason it is essential for one frame element to be vertically above another (in relation to the parting plane), the space between them must be cored out by a sliding block in the die. As most such structures fall into the medium-to-large size range, with a shortest dimension of, say, six to seven inches, a moving core adds enormously to the tool cost and appreciably to the production cost.

Where, therefore, the main opposed faces of a frame are preferably to be of the same area, and more especially if they are of irregular profile, the designer should consider whether it would not rather be better to utilize two flat—that is to say, not "box-like" —components held apart by spacers. If the latter, too, are die-cast, it is possible to modify them so that they perform mechanical as well as structural functions; thus, they may provide location pads or carry bush inserts.

This modification does, of course, entail several extra assembly operations, even if minor ones, and a course that frequently commends itself instead is to produce one main plate of the frame with integral spacers or legs, and to produce the mating element as a more or less flat plate (Fig. 20). This greatly facilitates the assembly of gear trains and similar interlocking mechanisms, for the legs may incorporate registers to help guide the free plate into position. As will be realized, there is no restriction on the position of the legs, or spacing pillars, other than those imposed by the locations of the mechanical elements. Even in a rectangular framework there may be more effective positions for the spacers than at the four corners.

So-called "flat" frames are seldom flat in the same way as a punched-out sheet-metal frame; they almost invariably carry minor functional elements such as bushes, lugs for the attachment springs, partitions forming guards for moving elements such as governors, and a host of other details. Since the rigidity of the frame controls the efficiency with which the moving elements mesh and operate, it is best to adopt some sort of girder section for the purely structural portions of the frame. A shallow I-section is very commonly used for frame sections.

Even in the location of two or three cored-out spindle bearings at specific points within the frame there is considerable scope for detailed variation of support strip positions with regard to each other and to the main elements of the frame. Some of the possibilities that present themselves with only two

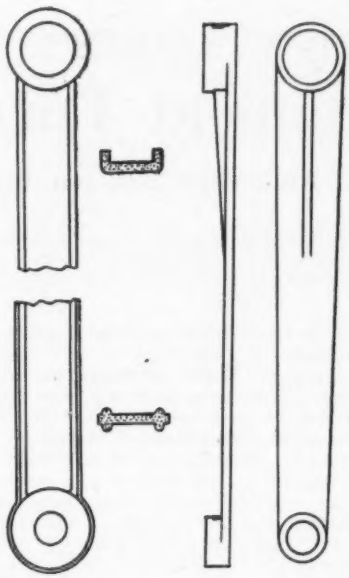
bosses to position are shown in Fig. 21. In a stamping one might determine the most suitable net merely by reference to their resistance to various deflecting loads, or even by the weight of the finished part, if the stresses encountered are so small as not to influence the choice.

For a die-cast frame these criteria both operate—maximum rigidity with minimum weight is always desirable—but in addition it may be necessary to take into account the ease of filling parts of the cavity that are more or less isolated from the main portion. Since the channel joining, say, the boss cavity to the frame cavity is of restricted area, it is clearly desirable to force the metal along it, and into the boss, at high velocity. This obviates premature chilling and promotes a good structure. There is, however, no single correct way of positioning boss and channel to achieve this; the best method to adopt depends, ultimately, upon the position in which the die-caster decides to place his sprue and runner channels.

In the case of a rectangular frame, there are three sprue-positions possible in practice; within the frame, or outside it and adjacent to either one of the long sides or one of the short sides. In current practice it is unlikely that a die-caster will adopt an internal sprue unless the frame is an exceptionally large one; with the machines currently available most jobbing die-casters are likely to adopt external feeding for any frame up to sixteen or twenty inches square. Most producers, too, favour gating to one of the long sides of the frame, for this produces a better-proportioned tool.

The channels joining the bosses are accordingly best orientated so that they run predominantly from one long side to another; they will then leave the main frame at points reasonably near the gate and there is a good chance that these transverse channels will fill completely before the metal going round the sides of the frame reaches their farther ends. The merging of the various metal streams will then take place in the main cavity, where their fusion is most easily effected. If this does not occur, and metal enters the far end of the restricted channel, an air-lock, or incomplete fusion, is quite likely. This particular disability is fairly easily cured (by providing overflows into which the air and chilled metal may debouch) so that channel position is among the less critical details of frame design. Nevertheless, it is worth while trying to visualize the way metal will flow through the cavity when designing the component.

It is convenient here to deal with links and levers, which in form have much in common with frame elements. In few applications are the stresses encountered very great and, particularly when changing over from cast-iron components, the chance should be taken to refine the shape and reduce sections.



Left: Fig. 22—Conventional designs for diecast levers and links often provide an unnecessary margin of strength

Right: Fig. 23—A lever with thin, flat web, stiffened locally by a rib

For levers of medium and large size, either I-section or channel-section (Fig. 22) may be adopted, the latter having the advantage that the whole cavity is formed in one die member and there is thus no difficulty about registration should the guide pins of the die become worn. Even as little as two or three thousandths of an inch misregistration is quite noticeable after trimming, where a component has little draft, for the projecting wall is face-broached by the trim die. The small bead shown on the I-section lever, which runs all round and forms the actual trimming perimeter, is a way of getting over this disability.

Small levers and links are almost invariably much thicker and heavier than they need be, both before and after conversion to die-casting. One often sees levers that, in operation, are subjected only to four or five in/lb. torque, which could safely be used with perhaps one hundred times that load. This disparity seems to result from the reluctance of designers to reduce boss sizes—wall thicknesses of journals, particularly—and a desire to keep the web reasonably proportional to the visual mass of the boss. Thus many small links have the unassailably good design shown in Fig. 22, when their function would be equally well served by the flat-webbed design of Fig. 23 which—when greater lateral stiffness is really needed—is slightly cruciform in section.

In one class of component this last argument does not apply; if the lever is visible and quasi-decorative—as, for example, are refrigerator handles—it is important to give an impression of

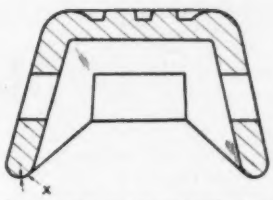


Fig. 24—The radii on the underside of a heavy-section handle render it less unpleasant to grip with the fingers

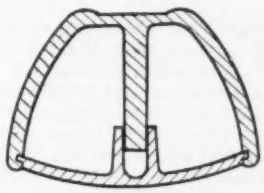


Fig. 25—A feeling of solidity is achieved in a composite "cold-formed" handle

massive strength as well as to provide adequate resistance to normal service hazards. All visible elements of this sort look better if they are cored out from the underside, and this generally, though not necessarily, entails the use of lateral sliding cores to form functional holes such as those in Fig. 24. Provided that the underside has good radii at x, so that it does not feel uncomfortably thin to the fingers, much unnecessary metal can be cored out.

The section thickness must, nevertheless, still be in excess of $2x$, in most places, and an expedient that has proved very effective in combining a really thin wall with a feeling of solidity is the cold-forming of die-cast handles. The component is cast with extended skirts on each side of the deeply-cored central portion, and in a subsequent press operation these side elements are turned inward until they nearly meet along the central median of the handle. This operation is very easily carried out on the zinc alloys at 20° or 30° above room temperature.

This method, which approaches sheet-metal practice, demands considerable deformation of the casting and it is desirable, therefore, to provide saddle-shaped bracing ribs to support those parts which are to remain undistorted. A related method, which calls for only localized deformation, is shown in section in Fig. 25. Here the skirts are omitted, and the cored-out interior has a shallow step running all round it. A mating casting, of conformable contour, fits when trimmed into the recess and lodges upon the step. The thin rim of the main casting is now ironed over with a roller-tool—a sort of linear "spinning" operation—or spanked down with a shaped punch to form a permanent closure. It is helpful if a peg-and-bush location is also provided, as in the example shown; this prevents all risk of the closure plate becoming displaced at the beginning of the forming operation.

HOT WORKING — COLD WORKING — PREFERRED ORIENTATION — ANNEALING

Mechanical Forming

By T. Ll. RICHARDS, B.Sc., Ph.D., F.I.M., F.Inst.P.

A symposium on practical aspects of metal physics occupied two of the sessions at the Spring Meeting of the Institute of Metals earlier this year. Among the contributions to this symposium was the one published here, slightly modified, on the subject of mechanical forming.

MOST of the improvements in methods of metal forming have come about by trial and error, and current practice is based on countless years of hard experience. Nevertheless, metal physics has a useful contribution to make in this field.

Physics has as its object the basic understanding of natural phenomena of the material world so that physicists may legitimately investigate the underlying principles of metal forming. If it is known precisely how various factors, singly or in combination, affect structure and mechanical behaviour, then production methods can be controlled intelligently, efficiently and economically.

Hot Working

Although every reasonable precaution may have been taken during the casting operation, problems will inevitably arise in subsequent working operations, due to such factors as segregation, unsoundness and hot-tearing, or stress cracking. Hot working by a method such as extrusion, rolling or forging, involving compressive rather than tensile forces, obviously offers the best chance of overcoming these difficulties. There is a reasonable chance that internal unsoundness can be eliminated by pressure welding, and without a doubt hot working is the most effective homogenization process since plastic strain promotes diffusion.

It should be appreciated, however, that plastic strain is essentially a change of shape without a change of volume so that a decrease in dimension in one direction is necessarily associated with an extension at right angles with the possibility of fracture, as, for instance, the familiar effect of barrelling and edge cracking when upsetting a hot cylinder.

In forging, such cracking can be avoided by a judicious choice of forging sequence, while in rolling, edge-cracking can be mitigated by compression on the corner edges. It is, perhaps, of more than academic interest that metals difficult to fabricate can be extruded quite easily when the whole press is under hydrostatic pressure.[1] The metallurgist, too, has learned how to put the almost inevitable fracture of cast metal, even under compression, to good effect in the Mannesmann process.

The temperature of hot working can be of considerable significance in determining the behaviour of the metal during subsequent operations, and also its ultimate structure and properties. Thus, for commercial aluminium,[2] for example, the amount of impurities in solution depends on the hot working temperature and this, in turn, affects the recrystallization behaviour after subsequent cold rolling and annealing. A similar effect is observed with tough-pitch copper when the ultimate recrystallization behaviour can be related to the hot working condition and, therefore, quantity of oxygen in solution.

The increase in diffusion rates with increase in temperature is not only due to increased atomic mobilities, but also to the generation of vacancies. These vacancies will be picked up by moving dislocations and tend to migrate to and condense at grain boundaries. It is probable that the so-called equi-cohesive temperature above which the grain boundaries are weaker than the crystals, corresponds to a critical concentration of vacancies. Grain boundary flow is almost certainly promoted by such a process.

Insoluble impurities are likely to be segregated at grain boundaries, and if these are liquid at elevated temperature then they cause hot-shortness, provided, of course, that the surface tension between the liquid phase and the matrix is low. A typical example is lead in brass.[3] In alpha-brass the surface tension is low, lead spreads around the grain boundaries and the brass breaks up during hot working. In beta-brass, on the other hand, the surface tension is high and the lead remains globularized, hot working is possible and the lead dispersion makes for free-machining quality in the cold state.

An obvious way of dealing with leaded alpha-brass is to break down the cast structure by cold working. It may be worth considering whether the deleterious effects of impurities of limited solubilities might not be overcome by a process involving quenching from an elevated temperature to produce a copious supply of vacancies, followed by a small amount of cold working and low temperature annealing to produce dispersed precipitation. It has been shown[4] that a somewhat similar treatment certainly leads to a much reduced work hardening of a Duralumin-type alloy, with a corresponding improvement in cold workability.

Cold Working

Metal physics research on deformation has been directed mainly to the behaviour of single crystals. Single crystals deform by slip, rather like a pack of cards on planes of densest atomic packing, and it is generally accepted that the shear occurs by the movement of dislocations. In a polycrystalline aggregate, on the other hand, each crystal must, to a first approximation, be deformed like the bulk specimen as a whole. This is not possible in a metal such as zinc, having only one family of slip planes.

It has been shown, however, that any strain whatsoever can be performed by a combination of five independent slip systems.[5] Since face-centred cubic metals have four slip planes with three slip directions in each, making twelve systems in all, a full and sufficient number are always available regardless of the orientation of a crystal with respect to the applied load. This accounts for the fact that, in general, the face-centred cubic metals are more ductile and more easily cold-worked than metals of hexagonal structure. Deformation by slip must be associated with lattice rotation, so that for a single crystal the slip plane rotates towards the tension axis and away from the compression axis. This means, for example, that on rolling magnesium the slip plane, that is the basal plane of the hexagonal lattice, tends to lie parallel to the strip surface, when no further deformation by slip can take place. This accounts for the low cold-rollability of magnesium. Another example is zinc, which, when extruded warm, develops a preferred orientation with the slip plane parallel to the rod axis and is then quite impossible to reduce further by cold drawing without serious internal fracture. With extruded beryllium, although the basal plane is again parallel to the extrusion axis, slip can occur on other planes and further cold working is possible.

When face-centred cubic non-ferrous metals and alloys such as copper and brass are cold rolled, they deform in initial stages up to about 40 per cent reduction in thickness by slip on a number of systems, as expected on Taylor's theory, the choice of systems depending on the orientation of individual crystals. However, with reductions in excess of this amount deformation occurs by shear on planes

inclined at about 40° to the strip surface and making traces in the surface at right-angles to the rolling direction. Such shear appears to be more directly related to the imposed strain of rolling than to the particular orientation of the individual crystals.

The change in mechanism of deformation at a reduction of about 40 per cent is reflected in the work hardening curve of 70:30 brass.[6] The first stage of rapid hardening is associated with slip and the second stage of slow hardening rates with what has been described as heavy shear.[7] The existence of the second type of shear has been somewhat ignored by metal physicists, but its practical implications and significance cannot be dismissed so lightly. The heavy shear traces represent planes of weakness, so that heavily cold rolled brass exhibits low longitudinal strength as compared with transverse strength and certain alloys can, in fact, disintegrate completely by the heavy shear process if rolled too heavily.

Preferred Orientation

As already indicated, slip causes lattice rotation and must, therefore, inevitably lead to preferred orientation. Without expounding at length on the theories of deformation textures, let us consider what happens when a face-centred cubic metal is rolled. As has been pointed out,[8] rolling may be regarded as a combination of compression normal to the strip and extension in the rolling direction. Since for a single crystal extension brings a <112> direction parallel to the tension axis, and compression a <110> direction parallel to the compression axis, then the expected rolling texture can be described as {110} <112>, that is, a texture with a {110} plane parallel to the plane of the strip and a <112> axis in the rolling direction. This is, in fact, the texture observed with rolled alpha-brass and most face-centred cubic alloys. The rolling textures of the pure metals, however, are significantly different[9] and it is useful to consider why this is so.

The {110} <112> texture is the one expected when only standard slip processes are operative. As already stated, a second shear process takes over with rolling reductions in excess of about 40 per cent, that is, before a very definite texture is developed. The alloys work harden more rapidly and to a greater extent than the pure metals and, consequently, are more brittle after reductions when standard slip is exhausted. This means that further deformation takes place in the alloys by heavy shear on planes symmetrical to the principal axes of the strip, and the partially developed {110} <112> texture is not only unchanged but is, in fact, enhanced.

In the more ductile face-centred cubic metals, such as copper and aluminium, on the other hand, brittle shear occurs on {100} planes when slip is exhausted and this has been shown[10] to lead to the pure metal texture, more recently[11] characterized as mixed {110} <112> and {112} <111> textures. The difference between the pure metal and alloy textures and the mechanisms by which they are formed are clearly evident from the appearance of the heavy or brittle shear traces in individual crystals, as seen in longitudinal sections.[7] The {110} <112> and {112} <111> textures are both composed of two components in twin orientation relation. The heavy shear traces occur in two common <110> directions in every crystal of the {110} <112> or alloy texture, while the traces of the {100} heavy shear of the pure metal occur only in crystals of the {112} <111> texture, and in one direction only in each.

Annealing

In the production of tube, wire or strip by cold working operations, it is often necessary to interpose one or more intermediate anneals, either because of the refractory nature of the metal, the power limitations of the plant, or in order to obtain the desired structure and properties in the final product. Annealing is an expensive operation, so that it is well worth while considering ways and means of cutting down the number to the barest minimum.

A possible practice in the production of H.C. copper strip, for example, would be to hot roll a slab to about 0·2 in., then cold roll to the final gauge without intermediate anneal. If freedom from preferred orientation and consequent directionality is not required or specified, then strip prepared in this way would be satisfactory. However, if freedom from directionality is specified, then an intermediate anneal must be included. It has been found[12] that, provided the final reduction was between 25 and 50 per cent, then complete freedom from directionality in the final strip could be realized regardless of the structure at the penultimate stage. This means that any texture that is developed by prior working and annealing is destroyed, presumably because the dislocation movements in the pure metal lattice involved in recrystallization can take place with equal facility on all available slip systems, resulting in random nucleation and crystal orientation. This would seem to be the right explanation in terms of metal physics, but, right or wrong, the method works in practice.

On annealing H.C. copper after very heavy rolling reductions, the well-known cube-texture is developed, which is associated with very pronounced directional properties. The study of the factors governing the development of cube-texture has received considerable attention.[12,13] Metallographic examination[7] of the three principal sections of heavily rolled strip confirms that, as expected, each grain in the polycrystalline mass is deformed in direct proportion to the reduction of the strip. Thus, grains of initial diameter of 0·02 mm. before rolling, form striplets of 0·002 mm. mean thickness after a rolling reduction of 90 per cent, and each grain takes up the orientation of one of the twin components of either of the two pure metal textures {110} <112> or {112} <111>. On annealing at an elevated temperature, recrystallization occurs with the formation of nearly 100 per cent cube-structure.

By rolling copper strip of three different initial grain sizes with various reductions in the range 80-99 per cent and annealing at a fixed temperature, it was seen from the microstructure[12] that 100 per cent cube-texture is formed when the crystals have been rolled to a thickness less than a critical value. Furthermore, by examining strips processed like those just described, but annealed at various temperatures, it was possible to estimate the critical value of crystal thickness for cube-texture formation at each temperature. It was also found[14] that the dimension was directly proportional to absolute temperature of annealing, having a value of about 2μ at 900°C. and about 0·6μ at room temperature. From this it was concluded that cube-texture is formed by the coalescence of twin rolling textures. This means that heavily rolled fine grained H.C. copper strip should recrystallize spontaneously at room temperature, and this was found to be so.[15] It was established[14] and later confirmed[16] from analyses of the kinetics of the recrystallization process, that the process was one of second-order, which is what would be expected if the process involved direct interaction and annihilation of dislocations of opposite sign at the rolled grain interfaces.

A number of possibilities suggest themselves for the prevention of cube-texture formation on annealing after heavy reductions. One is to ensure that the penultimate grain size is large, that is, by finishing the hot-rolling or carrying out the intermediate annealing at the highest practical temperature. This has the added effect that oxygen and other trace impurities are taken into solution and tend to anchor the dislocations at the grain interfaces. Phosphorus is particularly effective in this respect, for less than 0·01 per cent completely suppresses the formation of cube-texture.

The easiest method of testing for plastic anisotropy in strip is to form a cup from a circular blank. If the strip is directionality free, then a flat-topped cup is obtained. Cube-texture copper strip, however, yields cups with four very high "ears" situated at 0° and 90° with respect to the rolling direction.

Directional brass strip generally yields cups with four ears at 45° to the rolling direction, although cups with six ears have also been observed.[6] Since brass and other face-centred cubic alloys have a different rolling

texture from the pure metals, then it is not surprising to find they have a different recrystallization texture. The difference in mechanism of the recrystallization processes for the pure metals and alloys is rather more subtle. The formation of cube-texture from rolling texture has been likened[17] to a diffusionless phase transformation, and just as the latter can be regarded as occurring by a homogeneous shear, then so the cube-texture can be generated from the rolling texture by a twinning shear. It is reasonable to expect that the homogeneous shear processes required are more likely in a pure metal where every atom is of the same kind.

The change in orientation on recrystallization of heavily rolled alloys is, for brass, equivalent to a 30° rotation of the lattice about one of the <111> axes.[6] The process is considered to be one of atomic rearrangement rather than of block rotation. Again, it can be shown that a 30° lattice rotation may be brought about by a homogeneous shear of unit slip by one interatomic distance on every (111) plane. This is equivalent to a full dislocation movement on every plane, and it would seem that recrystallization of brass occurs by isolated dislocation movements.[18] In an alloy, with atoms of more than one species, it appears that recrystallization must involve dislocation movements as opposed to the possibility of the more homogeneous type of process in pure metals.

Indeed, the recrystallization characteristic of the alloys has two very significant practical implications, one in control of uniformity of grain size and the other of directionality. Thus, movement of dislocations in deformed brass on annealing results in polygonization or recrystallization *in situ* with a substructure of small crystals with orientation near to that of the parent grain. Furthermore, there is a tendency for grain growth to occur by coalescence of grains of similar orientation and, therefore, for the ultimate structure to retain some of the character of the initial structure. If, for example, coarse grain brass obtained by annealing at a high temperature is cold rolled and annealed at a lower temperature in an attempt to obtain a finer grain, a very irregular structure[6] will result. In order to obtain a really uniform structure, it is advisable with brass, and presumably with other alloys, to keep the grain size constant at intermediate stages, at least for the penultimate and final stages.

In addition, the polygonization process involves such small lattice rotation that cold rolling with low temperature intermediate annealing results in a build-up of preferred orientation in the final strip. The only sure way of eliminating preferred orientation and consequent directionality in brass is to use a fairly high penultimate annealing temperature. This produces a coarser grain size at that stage, with greater misorientation between grains and, therefore, a higher probability of random nucleation.

In a highly condensed survey of this kind it has only been possible to deal with a few of the main problems associated with production of wrought metals when basic principles can be usefully applied and many important aspects, particularly relating to surface quality have necessarily not been dealt with. Furthermore, no reference has been made to problems of mechanical forming in the usual sense of the term, but it may be argued that the problems are essentially the same as those encountered in production of wrought metal, with the added greater complexity of stress and strain distribution.

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Readers' Digest

ANALYSIS

"E.D.T.A. Titrations." *By H. Flaschka. Published by Pergamon Press Ltd., 4-5 Fitzroy Square, London, W.1. Pp.* 138. *Price* 42*s.* 0*d.*

THE appearance of yet another book on the subject of complexometric titrations employing E.D.T.A. needs some justification. Professor Flaschka's work is, however, unique, even in this field, and will strongly appeal to students as well as to works chemists and other analysts.

An attempt has been made to rationalize and clarify the underlying theory of complexometry, as well as to enlarge on the now too familiar descriptions of metallochrome indicators employed in this work. If the first few chapters are read and digested carefully, many of the all too frequent errors made by chemists and students first experimenting with this attractive reagent may be largely avoided.

The nature and properties of E.D.T.A. and its related salts are fully discussed, together with the numerous metal chelates which it so readily forms. A table of stability constants, with a full discussion as to its correct use and interpretation, is also included and forms one of the most valuable sections of the book.

Where the work is demonstrably unique is in the series of simple yet lucidly illustrative experiments with E.D.T.A. and various metal ion indicators. By following these carefully, the reader could not help but become quickly acquainted with the various analytical applications and limitations of this, dare we suggest, somewhat overrated reagent. On reading this experimental section of the book, it is quickly realized why relatively few methods are applicable to metallurgical analysis, the reagent is often self-condemned by its own inherent versatility. For titrating pure salts it is unsurpassed, but when separations are involved, established procedures will generally lose little by comparison with chelatometric methods. What Flaschka's book does, perhaps quite unwittingly, is frequently to reveal the limitations of E.D.T.A.; in this respect it is to be further commended, since most other works have been uncritical and to a large extent have consisted of a series of literature references to hundreds of virtually useless methods.

It is to be regretted that Flaschka's book did not appear somewhat sooner, as it seems to contain all the relevant information necessary to enable a trained chemist to assess the value or otherwise of an E.D.T.A. method encountered in the literature.

For the already overworked student it will serve as a concise and readily readable work on yet another branch of analytical chemistry which he must of necessity study.

Only two criticisms seem worthy of mention; the free use of ascorbic acid as a reducing agent may be justified in the U.S.A., in Britain the "Analar" grade costs about £11 for 500 gm. Secondly, the price of the book: for just over 130 pages 42s. seems positively staggering.

K. E. L.

News Review

Seven Weeks

During the past seven weeks in which this journal, in common with others, has had to suspend publication because of the unfortunate printing dispute, a number of events have taken place in the industry and much information has become available which has had to be held up. Below we are now able to review some of these events and bring our readers up-to-date in this matter to summarize such information.

B.N.F.M.F. Golf

At the Sutton Coldfield Golf Club, Streetly at the early part of last month, the **British Non-Ferrous Metals Federation** held its annual golf competition. The morning round for the "Horace W. Clarke" Cup was won by Mr. B. H. Treadwell (The Mint, Birmingham) with a net score of 67 and the runner-up was Mr. C. W. Darville (Frederick Smith and Co.) with a net score of 71.

In the afternoon a Four-Ball against Bogey competition was won by Mr. L. C. Spencer (John E. Mapplebeck Ltd.) and Mr. H. H. Winter (Aston Chain and Hook Co. Ltd.).

Canning in Australia

New arrangements have recently been made with regard to the selling of their products and of manufacturing arrangements in Australia by **W. Canning and Company Ltd.,** of Birmingham. The company has announced that they have arranged to extend their interests in Australia by acquiring a holding in Lawrence Smith and Company (Pty.) Ltd., of Sydney, with whom they have been closely associated for over 50 years.

The name of the Australian company is to be changed to Lawrence Smith and Canning (Pty.) Ltd., with head office and warehouse in Sydney and a branch in Melbourne. The Australian company is well equipped and staffed to supply and service all Canning plant, equipment, solutions and other materials, including automatic plating plant and polishing machinery.

Standards Engineers

Establishment in this country of a formal association of standards engineers was brought significantly nearer at the annual conference of standards engineers which was held recently in London. The large attendance of some 250 engineers, designers, purchasing officers and representatives from industrial management, technical colleges and government departments, indicated the ever-growing interest of industry in the application of standards techniques.

This is a subject increasingly recognized as a powerful aid towards more efficient design, purchasing and production, a point which was emphasized by Mr. H. A. R. Binney, director of the British Standards Institution, who took the chair at the conference, which was organized by a joint committee of the B.S.I. and the Institution of Production Engineers.

A Servicing Scheme

After sales service is an important part of the policy of **Dallow Lambert and Company Ltd.** and this company has recently announced a new development of this policy in the introduction of a unit dust collector servicing scheme.

This scheme has been introduced for the purpose of keeping Dallow Lambert unit dust collectors in good condition and functioning efficiently. A fully trained service engineer makes regular visits at six-monthly intervals, or at other dates mutually agreeable, and services each dust collector, replacing any parts necessary to put the equipment into first class working condition. Each firm participating in this scheme is provided with a Maintenance Service Register which can be shown to H.M. Inspector of Factories during his periodic visits.

A Retirement

After fifty years service with **McKechnie Brothers Limited,** Mr. Hollingworth recently retired and at a cocktail party given in his honour a presentation was made to him by Mr. E. Hartles, commercial director of the company.

Mr. Hollingworth joined the company at their Blaydon-on-Tyne works in June 1909 and in September the following year was transferred to Birmingham where he became assistant in the laboratory and studied chemistry under Dr. Price and metallurgy under Mr. Hiorns at Suffolk Street. In due course he was entrusted with the inspection and buying of non-ferrous scrap but this work was interrupted by the first world war during which he served in the armed forces. He returned to the company's service in 1919 when he became technical sales representative in the Birmingham area.

Gas Cutting Equipment

An agreement has been concluded between **British Industrial Gases Ltd.,** and the Harris Calorific Company of Ohio, whereby the latest American designs in oxy-fuel gas cutting equipment will be manufactured in Great Britain. The agreement allows B.I.G. to export the equipment to all countries except Canada, Australia and South Africa.

Two of the items now being marketed are a gaugeless regulator which requires little or no servicing and which has been approved as 100 per cent safe by the American Underwriters' Laboratories and a handcutting torch for all types of fuel gas, especially propane.

An Open Day

On Saturday, July 11 last, an Open Day for friends was arranged by **The Projectile and Engineering Company Ltd.,** at their works at Thessaly Road, Battersea, London, S.W. The invitation included all the company's employees and families and consisted of a complete tour of the works where various machines were in operation.

Among the special items to be seen by the visitors were a Safety Exhibition, a typical working day provided by the apprentices, the press shops, the shear shop, die casting machines, machine

NOTICE TO READERS

BECAUSE of the recent stoppage in the printing industry, publication of METAL INDUSTRY was suspended after the issue of 19th June. The present number, which commences Volume 95 is therefore the first for seven weeks. We regret the inconvenience caused by this break in continuity. This issue contains a section briefly reviewing the more important events of the period including market movements.

Current subscriptions will be adjusted by postponing the renewal date for the period of the stoppage.

Mr. E. Hartles, commercial director of McKechnie Bros. Ltd. making the retirement presentation to Mr. H. Hollingworth

assembly shops, and two chassis frame assembly lines in operation. A demonstration of arc welding assembly was also given. Other parts of the firm's activities were demonstrated in the machine shop, enamelling plant, axle case shop, stores, and of course the general offices. Tea was provided in the canteens.

Trading Agreement

A reciprocal trading agreement has been made between **Amber Chemical Industrials Ltd.,** and the D. A. Stuart Oil Co. Ltd., of Chicago and Detroit (in association with Canadian D. A. Stuart). By this arrangement, which operated from August 1 last, the British company is appointed sole distributor and licensee in the United Kingdom, Eire, South Africa, Australia and New Zealand for all the products of D. A. Stuart.

Attracting Youth

At the Chippenham works of **Westinghouse Brake and Signal Company Ltd.,** the next "Introduction to Industry Course" will be thrown open to boys taking "A" level scientific subjects at Public and Grammar Schools. This course is of one week's duration from Monday, August 24, until Friday, August 28.

These courses are designed to give boys a good insight into the engineering industry, how it works, the training facilities available and future prospects. Mid-day meals are provided, and travelling expenses to those living over 5 miles from the works. For anyone living further afield lodging expenses are paid.

New Representative

To represent them in the North of England, **Hilger and Watts Ltd.** have appointed Mr. D. G. Heywood, who will be located in Sheffield and whose area will be Yorkshire, Lancashire, Cheshire, and North Lincolnshire. Mr. Heywood's particular province will be the firm's analytical instruments, spectrographs, polychromators, spectrophotometers, polarimeters, refractometers, absorptiometers, colorimeters, etc.

ZDA Competition

A competition for improving designs and methods of joining and fixing eaves gutters made from sheet zinc has been announced by the Zinc Development Association.

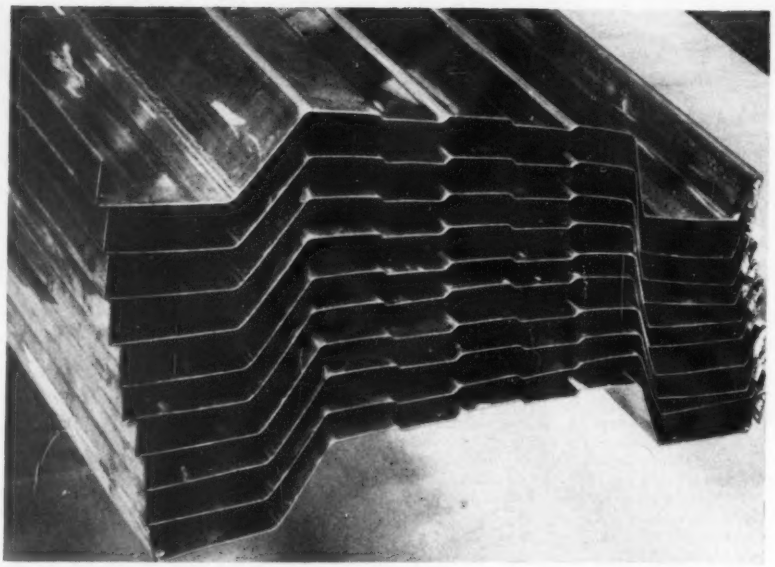
The promoters invite architects, students, building trades operatives and others to submit drawings and/or models before September 30 next. A distinguished panel of assessors will award two prizes, one of £75 and the other of £25, and the winning designs will be shown on the association's stand at the 1959 Building Exhibition at Olympia.

Copies of the conditions of entry are obtainable from the offices of the association at 34 Berkeley Square, London, W.1.

Aluminium Sheet Cladding

There is no doubt that unpainted aluminium for the exterior covering of buildings in a wide range of atmospheres has been proved to be very suitable. A new type of aluminium sheet cladding for this purpose has now been introduced by the **British Aluminium Company Ltd.** in "Rigidal Seamwall" which has been designed specifically as a wall cladding having a bold profile particularly suitable for large buildings.

Seamwall is not intended for roof coverings because the seam joint in the trough, although satisfactory for walls, could not be relied upon for weather-proofing sloping roof surfaces. There are, however, a number of advantages claimed for this new system. The scale and profile are such as to maintain texture and shadow value over large expanses of wall cladding.



Rigidal Seamwall, the new aluminium wall cladding designed by British Aluminium Co. Ltd.

Availability in lengths up to 40 ft. (12·19 m.) enables end laps to be avoided with their attendant discontinuities in the wall pattern. Concealed fastening where required, but equally adaptable to traditional sheet fastening methods where preferred. Adaptability for fixing to any type of sheet rail. No drilling, punching or locating of holes is necessary during fixing. Joints completely sealed by built-in-caulking; Adaptable 12 in. (304·8 mm.) module, and it may be used in conjunction with standard insulating materials where thermal or fire insulation is specified.

Rigidal Seamwall panels may be fixed to angle or channel sheeting rails or to timber battens. Where concealed fixing is required, a simple clip is placed over the single upstand of the panel and firmly secured to the sheeting rail. The double upstand, or overcloak of the neighbouring panel, containing the appropriate amount of caulking compound, is then pressed home over it. Panels are normally supplied ready caulked, unless otherwise requested.

Sales Appointments

It has recently been announced by **Anti-Dust Services Ltd.,** that Mr. P. T. Butler and Mr. N. E. Griffiths have been appointed sales representatives with the company. Mr. Butler will be covering the South London and South-East England area, and Mr. Griffiths the North of England and Scotland.

Computers to Streamline Operations

A "Leo II" automatic office for use in their works at Edmonton has been ordered by **British Oxygen Gases Ltd.** The equipment which is to be installed at the end of this year will include magnetic tapes, a large magnetic drum and high speed printers, and will then be one of the most powerful assemblages of commercial computing equipment installed in an industrial organization in the country.

This unit has been acquired primarily to carry out a very comprehensive series of production scheduling and control tasks for the company's Edmonton works, but will also give general service to the remainder of the group.

A "Bronze World"

An unusual order was received some time ago by **McKechnie Bros. Limited,** of Birmingham, from the Birmingham Guild Limited who had been chosen by the Imperial War Graves Commission to manufacture and erect the War Memorial to the Commonwealth Air Force which was unveiled by Her Majesty the Queen at Green Island, Ottawa, during her visit there last month.

The memorial takes the shape of a globe "framework" executed in extruded metal with solid cast bronze land masses superimposed. The globe, 10½ ft. diameter, with vertical centre axis, stands on a bronze plinth embellished by three statuettes of beavers, again in bronze. The whole construction is surmounted by a bronze eagle which has a wing span of 8 ft.

McKechnie Bros. were faced with the problem of supplying a material of intrinsic strength and good cold working properties. At the same time, the material had to provide a pleasing finish and match the cast land masses. The lines of longitude forming the north-south part of the framework were a straightforward bending and forming operation. It was the other part of the framework—the lines of latitude—that provided the problem. The "equator" had the same liberal radius as the longitudinal lines, but the latitudinal lines north and south of the equator had to be of diameters reducing in proportion down to twenty-one inches for those nearest the "poles." Moreover, these smaller rings had to be formed at an angle to account for the curvature of the earth's surface. Those nearest the poles had to be bent virtually "on edge." Obviously, material as small as 1½ in. × ¾ in., undergoing operations of this sort, needed to be of exceptional cold working qualities.

In the McKechnie range of "Manganese Bronzes" such a material was to be found.

The alloy used, designated "K.S." Quality, is one used extensively in architectural work in the form of both rod and extruded sections. It is a versatile material which, apart from the qualities already mentioned, can also be readily hot stamped, and the small percentage of lead in the alloy helps in machining operations. Controlled extrusion conditions can be employed to produce a chocolate-coloured finish—an appearance much in demand. "K.S." Quality falls within the British Standards Specification 250/A (Class B).

Electric Furnaces

It is reported from **Birlec Limited** that the designs for standard Birlec box furnaces have been re-styled to improve their appearance and to rationalize their manufacture. A further effect of introducing the new designs has been a significant reduction in prices throughout the range. Specially designed to give temperature uniformity across the full hearth width, the new Birlec GP furnaces are built for two temperature ranges. For operation at temperatures up to 1,000°C., five furnaces in the range GP.1000 are available. They range in capacity from 1·5 cu. ft. to 26 cu. ft. with ratings from 20 kW to 70 kW. The four sizes of GP.1400 furnace operate at temperatures up to 1,400°C. Their capacities and ratings range from ¼ cu. ft. to 3 cu. ft. and 16 kW to 60 kW respectively.

Repair and Maintenance

It has been jointly announced by the **General Electric Company Ltd.,** and **Wild-Barfield Electric Furnaces Ltd.,** that with effect from July 1, 1959, the repair and maintenance service for all G.E.C. valve operated high frequency generators will be carried out by the Wild-Barfield company from their works at Otterspool Way, Watford By-Pass, Watford, Herts.

A Golfing Event

For the third year in succession the weather favoured the **Non-Ferrous Club** on the occasion of the annual tournament of its Golfing Society. Held at Stratford-on-Avon Golf Club, the competition in the morning was a foursome played against bogey for the METAL INDUSTRY bowl which was won by Mr. H. T. Viney of METAL BULLETIN who finished 1 up on bogey. The afternoon greensome competition was played against bogey the winning pair being J. R. D. Wilde and E. Shenton.

The day was rounded off by a dinner at the Welcombe Hotel, Stratford-on-Avon, followed by the annual meeting of the golfing society. At this meeting Mr. W. H. Demel was elected President of the society, Mr. G. F. Litherland elected captain and Mr. R. L. Deutsch, secretary and treasurer.

Hydraulic Drill Head

Recently introduced by **W. J. Meddings Limited** is an air hydraulic unit drill head, type HDH/VS. This model is fitted with a variable speed drive unit, allowing for the choice of any spindle speed in the ranges 320-2,880 r.p.m., or 480-4,320 r.p.m.

The makers state that the air hydraulic feed unit incorporated in this head provides fast approach, infinitely variable drilling feed and fast retraction. Also that this combination of infinitely variable spindle speed with infinitely variable feed will ensure exactly correct machining conditions, and should commend this unit to users who have "difficult" material to drill or tap.

Fuel Efficiency

Details are now available of the sixth annual refresher course on "Current Practice in Fuel Efficiency," to be held at the Clarendon Laboratory, Oxford, from September 21 to 25 next. This course is organized by the National Industrial Fuel Efficiency Service with the support of the Southern Regional Council for Further Education.

The preliminary programme and registration form may be obtained from the course secretary, N.I.F.E.S., Ailsa House, 181 King's Road, Reading. Applications for enrolment must be made not later than September 7 next.

European Subsidiary

Another company is being set up in Europe by the **Metal Industries Group.** This is Fawcett Preston (Europe) S.A., which has been formed to handle the sales and service of products manufactured at Bromborough by the group's engineering subsidiary, Fawcett Preston and Company Limited.

Headquarters of the new company will be in Paris at 6 Square de l'Opera, where registration took place last month.

Spray Gun Modification

When air compressed to a pressure of 60 to 80 lb/in^2 travels through the tortuous paths formed in the body of a spray gun, there is inevitably a pressure drop caused by skin friction to the passage of this air. The Bullows-Binks model 19 spray gun has been the subject of considerable development work on this problem. By making minute drillings to all parts of the air passages, it has been possible to study the behaviour of the airstream in terms of velocity, direction and pressure within the gun body.

The lessons learned have been applied to all guns now being produced, and modifications to the air passages are stated to have produced a substantial improvement in performance of this gun with all its high speed set-ups. An advantage of these modifications is that they can be made to existing gun bodies at the makers' works at a cost of only 10s. 6d. per gun.

Luncheon Meeting

At the Queen's Hotel, Birmingham, on July 1 last, the **Non-Ferrous Club** held its usual monthly meeting, the guest speaker on this occasion being the Chief Education Officer for Birmingham, Mr. E. L. Russell who, in his address praised the developments of the last decade in higher technological education and said that in this field history was being made.

While regretting that there was so much time lag between the desires of Parliament being made known and their implementation, Mr. Russell said that in spite of this he thought great strides had been made, and the development of sandwich courses was an outstanding event in higher education. He thought the old system of part-time courses tended to limit the students' social attainments and produce a somewhat narrow view of life, but that this would not now be so prevalent. In passing Mr. Russell mentioned that 64 of the students of the Birmingham College of Technology were over 21 years of age and he felt this clearly indicated that the old idea of "night school" was no longer applicable.

At this luncheon meeting a collection was taken on behalf of the Commonwealth Society for the Blind and a sum of £11 15s. 0d. was realized.

U.K. Tin Stockpile

In its recent announcement relating to the disposal of 2,500 tons of tin through the International Tin Council Buffer Stock, the Board of Trade also gave notice, in accordance with the requirements of the International Tin Agreement, that they have available for disposal from January 1, next year, a further 2,500 tons of tin which is no longer required for strategic purposes.

It will be decided later after consultation with the ITC and in the light of circumstances at the time whether sales of this quantity will also be made through the Buffer Stock manager or direct through brokers on the London Metal Exchange. Sales will, if necessary, be spread over several months.

Aluminium in Norway

A new section of plant was officially inaugurated recently at the A/S Ardal og Sunndal works, the State-owned concern in Norway. Called Ardal II, it has an annual output capacity of over 36,000 tons, bringing the capacity of the Ardal plant to about 65,000 tons per year. A third stage of expansion of the Ardal is also already under way and this will, it is said, have an annual output capacity of over 32,000 tons. This new capacity is scheduled to go into operation early in 1961.

Members of the Non-Ferrous Club Golfing Society at their annual tournament held at Stratford-on-Avon

Industrial News

Home and Overseas

Platinum-Titanium Electrodes

Agreements have been signed between **Imperial Chemical Industries Ltd.** and **Engelhard Industries Inc.** covering the production and sale of platinum-titanium electrodes. The production of these electrodes by the Metals Division of I.C.I. is now well established and has already led to their extensive use in industry. The American company will produce similar electrodes at their factory in New Jersey, U.S.A.

The use of the new electrode for the production of chemicals such as chlorine is likely to lead to increased operating efficiency and lower costs together with substantial savings in servicing and maintenance. The two organizations will institute a continuing joint research programme and will pool all information acquired.

A New Address

The whole of the stocks of **Stedall and Company Ltd.**, and its associated companies, are now housed in new premises at 192/204 Pentonville Road, London, N.1. The exception to this move is the Metal Division of the company (aluminium, steel, brass and copper, etc.), which has already moved to St. John's Wharf, 29 Carnwath Road, Fulham, London, S.W.6.

Change of Address

News from **The Wolverhampton Metal Company Ltd.** is that they have now moved their London Office from Tooks Court to a new address at 64 George Street, London, W.1. The telephone number of the new office is Welbeck 0144-5.

A Golf Meeting

Preliminary notice has been given by the **National Association of Non-Ferrous Metal Merchants Golfing Society,** that the autumn meeting will take place at the Edgbaston Golf Club, Birmingham, on September 23 next. As is customary there will be a dinner the previous evening at the Midland Hotel, Birmingham.

An Improved Respirator

Manufactured by **Mine Safety Appliances Company Ltd.**, the "Dustfoe 66" respirator has recently been granted H.M. Factory Inspectorate certificates approving its use under the Asbestos Industry Regulations 1931, and the Iron and Steel Foundries Regulation 1953.

Several new features have been incorporated in the latest model of this respirator which now has a newly contoured face cushion which gives a better and more natural fit and provides much greater wearing comfort. More sponge stock has been added and this ensures an air-tight seal on most facial types. The sponge Neoprene is said to be more durable and will not harden in use. The cushion is easily replaceable.

Newly-designed exhalation valves now fitted to the respirator are larger than those used previously, and reduce resistance to a minimum. They are spring-retained to eliminate the variation in resistance which can be disturbing to the wearer. This system also prevents accidental removal of the valves. The complete respirator, including the headband, weighs only three ounces.

Change of Name

In 1949 when radioactive isotopes were made available by Harwell for commercial use, Baldwin Instrument Company were quick to appreciate their potential application for non-contact thickness measurement and control of materials in continuous production.

The company now offers a most extensive range of nucleonic thickness and control gauges which are employed in a wide variety of industries including the manufacture of hot and cold ferrous and non-ferrous sheet and tube. Expansion and development in these new fields has necessitated a recent move to much larger premises in Dartford and it became apparent that the title Baldwin Instrument Company was somewhat of a misnomer.

The name of the company has therefore been changed to **Baldwin Industrial Controls**, a title which more clearly illustrates the company's service to industry.

Titanium Production

To meet the increasingly specialized demands of important consumers, **I.C.I. Metals Division** have added four new materials to their production range of wrought titanium and titanium alloys. These comprise two additional grades of commercially pure titanium, I.C.I. Titanium 125 and 150, and two alloys, I.C.I. Titanium 230 and 679. These two alloys have previously been available on a development basis.

The addition of two new materials widens the range of I.C.I. commercially pure titanium to six grades, each with closely controlled strength and ductility. The softest and most ductile material, I.C.I. Titanium 115, has a maximum tensile strength of 26 tons/in^2 with a minimum proof stress of 13 tons/in^2; the strongest, I.C.I. Titanium 160, has a tensile strength of 40-50 tons/in^2 with a minimum proof stress of 30 tons/in^2. With four intermediate grades now available, the design engineer can select the material which offers the best combination of strength and ductility for his particular needs. All grades can now be bent round a radius of 1T, except for I.C.I. Titanium 160 which has a bend radius of 2T.

Formerly known as experimental alloy EX.012, I.C.I. Titanium 230, a copper alloy, has been developed for applications, mainly in the aircraft industry, where medium strength at moderate temperature must be combined with good weldability and formability. This titanium is a binary alloy, the properties of which can be modified by heat treatment. In the soft, solution-treated condition, it has a minimum tensile strength of 32 tons/in^2; this can be raised to 45-53 tons/in^2 by subsequent ageing. Strength is retained well at temperatures up to about 200°C.

Readily formed and welded, I.C.I. Titanium 230 combines some of the strength advantages of titanium alloys with the easier workability of softer material. It is particularly suitable for complex fabricated assemblies in aero engine production and is available in a variety of wrought forms, including sheet, bar, rod, wire and extrusions.

I.C.I. Titanium 679 is a high-temperature creep-resistant material, previously known as EX.013A. It is a complex titanium alloy containing tin, zirconium, aluminium, molybdenum and silicon. It has been developed to withstand high stresses at temperatures above 400°C. and shows remarkable resistance to creep in the range 400-500°C. At 500°C., I.C.I. Titanium 679 has a short term tensile strength of 52 tons/in^2 and will withstand a stress at 12½ tons/in^2 for 300 hours before showing a plastic strain on 0·1 per cent. At 400°C., resistance to plastic strain is nearly three times as high at 36 tons/in^2. Specially developed for aero engine components, notably compressor discs and blades, this titanium 679 is produced mainly in the form of rod, bar and billet for forging.

A New Company

Centred in Cambridge a new company has been formed to advise on design and manufacture all types of special vacuum equipment for use in the high, medium or rough ranges, with special emphasis on metallurgical equipment and batch and continuous metallizing.

This new company—**Torvac Limited**—with a development works at Histon, has access to experience accumulated over many years in the design, construction, testing and operation of vacuum, metallizing and other vacuum processes.

Machine Tool Exhibition

It is announced by **Peco Machinery Sales (Westminster) Ltd.,** that they will be exhibiting one of their model 40DC5 pressure die-casting machines at the Sixth European Machine Tool Exhibition which is being held in Paris next month.

Demonstrations will be carried out during the exhibition in conjunction with a Hedin electrical melting and holding furnace. This new series of die-casting machines has been designed to meet the trend towards aluminium, although the highest possible standard is maintained when casting brass.

Powder Metallurgy

It is reported from New York that **Metal and Plastic Components Ltd.** has just been elected to membership of the American Powder Metallurgy Institute, technology division of the Metal Powder Industries Federation.

Metal and Plastic Components Ltd. is a Birmingham, England, company manufacturing a variety of products by the powder metallurgy process. They are a subsidiary of Birmingham Small Arms Company Ltd.

Electrometallurgy

In the Spring of next year the Electrometallurgical Center of the Italian Metallurgical Association will organize a Symposium on the Electrolysis of Molten Salts and the Production of special non-ferrous metals by electrothermic method in Milan.

Visits to research institutes and electro-

metallurgical works are also proposed after the Symposium. Full information regarding this event may be obtained from the Secretary to the institute at Via Moscova 16, Milan, Italy.

Atom School

An announcement from the U.K. Atomic Energy Authority refers to the second course this year on the uses of radioisotopes, specially planned to suit the needs of company directors and senior executives, which is to be held at Harwell from September 29 to October 2 next. These courses are primarily for persons who have had no training whatever in radioactivity and are intended to stimulate ideas rather than to teach techniques. Delegates are accommodated at an Oxford College for four nights and brought daily to Harwell by coach. The fee for the course, inclusive of all accommodation, meals, transport and lectures is £40.

Clothing Lockers

Five hundred industrial lockers for protecting the clothing of employees were recently installed at the Windscale Atomic energy plant. These lockers, made by Vernons Industries Ltd., are constructed so that 12 can be erected in one square yard and are made from Zintec, the sheet steel which has a coating of pure zinc electrolytically deposited on the surface, and which is produced by **John Summers and Sons Ltd.**

The special coating of Zintec protects the steel against corrosion, a particular asset where lockers are installed in washrooms which may have a damp or steamy atmosphere. The lockers can be heated by steam, electric or plenum systems and are specially suitable for factories or industrial premises where the type of work calls for complete and dry protection of clothing.

A Portable Dewpoint Meter

A dewpoint meter developed in America and now being manufactured in this country under licence is finding, by virtue of its easy operation and consistent accuracy, applications in a wide range of processes where moisture contents of dry air and other gases must be determined. Typical uses of the meter include checking the dryness of air supplies for refrigeration and air conditioning and of atmospheres used in heat treatment processes. Other uses have been found in the operation of supersonic wind tunnels, the assembly of high voltage transformers and the making of glass to metal seals.

The meter known as the Alnor Dewpointer, is portable and self contained, requires no coolant, and has a measuring range from −80°F. to room temperature or from 0·0015 per cent to about 2·75 per cent water vapour by volume. The measurements are made by compressing a sample of the gas to a pressure at which, on suddenly releasing the pressure a mist is formed, the temperature of the dew point then being calculated from the temperature and pressure ratio before expansion. Easy conversion of the sample temperature and pressure ratio to dew point temperature is made with an Alnor Dewpoint Calculator.

The gas to be checked is drawn through the meter into an observation chamber with a hand pump, the chamber being fitted with a purging valve to allow a previous gas sample to be cleared. The chamber is illuminated to make the mist easily visible. The pump is designed to prevent the slightest trace of moisture being introduced into the chamber by the wiping action along its barrel. The meter is fitted with a sensitive thermometer mounted in clear perspex and a pressure ratio gauge to give quick direct readings of the ratio of atmospheric pressure and observation chamber pressure. The meter can be battery operated or connected to the mains. The Alnor Dewpointer is being marketed in this country by the **Electric Resistance Furnace Co. Ltd.**

Laboratory Shaker

Designed to minimize noise and vibration the BTL "Bara" laboratory shaker is made of sheet steel and rubber lined. It is supported on four rollers and is oscillated by a connecting rod from a crankshaft which is driven from a gear motor by a V section canvas reinforced rubber belt. Racks are held rigidly in place by a quick release locking lever. An attachment to hold bottles is also available.

The length of stroke is 1½ in. and a rate of 275-280 oscillations per minute is easily attained. The unit is made by **Baird and Tatlock (London) Ltd.**, the overall size of the equipment is 30 in. by 11 in. by 8 in. high, and the weight is approximately 44 lbs.

Welding Technology

Courses which are being organized for the coming season in September and October this year are announced by the School of Welding Technology under the auspices of the Institute of Welding. The advanced course for welding engineers is to be held from September 22 to 30 and is designed to provide, at an advanced level, the latest information and views, both from this country and abroad, on all topics of importance to welding engineers and others responsible for the control of welding.

Other courses are being arranged as follows:—October 12 to 16, on Welded Design and Construction of Pressure Vessels and Pipework; October 26 to 28 on Control of Distortion; and October 29 to 30 on Residual Stresses and Stress Relief.

Full details of all these courses may be obtained from the Institute of Welding at 54 Princes Gate, Exhibition Road, London, S.W.7.

Industrial Safety

In view of the increasing interest of protective lenses in safety spectacles in British industry, the Safety Equipment Division of **J. and R. Fleming Ltd.**, have published a booklet entitled "Eyes at Work" which is obtainable from them on request.

In addition to technical information concerning "Armorglas" toughened corrective/protective lenses, the booklet contains valuable information on their prescription and dispensing through the usual ophthalmic channels together with details of fees approved by the Association of Optical Practitioners for the professional services involved.

Minibition at Folkestone

There will be 124 stands at the **Purchasing Officers' Association** Minibition which is being held at Folkestone this year from September 24 to 26. A wide range of industrial products will be exhibited by 104 companies and as usual there will be a competition for the best stands and there will be two classes of award, one for educational value of the display and the other for attractiveness of design.

Among the firms exhibiting are the following:—A.P.V. Paramount Ltd.; Aerostyle Ltd.; Albright and Wilson (Mfg.) Ltd.; Birfield Industries Ltd.; British Oxygen Gases Ltd.; Goodlass, Wall and Co. Ltd.; Hadfields Ltd.; Jenson and Nicholson Ltd.; Langley Alloys Ltd.; Midland Silicones Ltd.; Minnesota Mining and Manufacturing Co. Ltd.; Morgan Crucible Co. Ltd.; Rozalex Ltd.; and West Yorkshire Foundries Ltd.

Flow Measurement

It is understood that **Honeywell Controls Ltd.** are now able to supply a system providing automatic compensation for either temperature or pressure, or both—using the Sorteberg Force Bridge pneumatic relay. This is essentially a multiplying and dividing unit which corrects the flow signal for pressure and temperature changes.

The pressure and temperature transmitters are calibrated from absolute zero to the maximum values for which compensation is required; expressed in absolute units. Transmission is such that zero absolute is 3 p.s.i., whilst the maximum reading gives 15 p.s.i.

The flow transmitter is a standard differential Converter, or similar transmitter, which does not incorporate square root extraction.

Magnetic Drum Separator

Specialists in magnetic engineering, **Rapid Magnetic Machines Ltd.**, have given details of their permanent magnet wet drum separator which is stated to meet all requirements of the up-to-date heavy media recovery flow sheet.

Elimination of the densifier demands a magnetic concentrate of at least 2·2 sp. gr. when using magnetite and the desirability of treating the effluent from the wash screens directly without pre-thickening makes it imperative that maximum magnetite recovery be achieved even when treating very dilute slurries. The Separator incorporates a slimes overflow weir and adjustable orifice rings in tailings outlet to eliminate the need for valves. Special attention has been paid to the header box which ensures proper presentation of the feed to the drum and eliminates overloading under severe surge conditions.

The 30 in. dia. drum, provided with expendable stainless steel outer covers, and available in widths up to 72 in., is energized by a powerful multipolar Alcomax permanent magnet unit, eliminating all electrical wiring and accessories except those necessary for the drive motor. Single stage recovery at 80 Imperial gallons per min. per foot of magnet is exceptionally high under a very wide range of feed concentrations, a typical figure quoted from an actual installation being 99·6 per cent recovery at 1·38 per cent magnetite in feed (by weight). This represents a magnetite consumption of less than a tenth of a pound per ton of coal washed, based on an average of 150 gallons wash water per ton of coal. A clean magnetite concentrate of 2·4 sp. gr. is produced, independent of feed concentration.

Men and Metals

In succession to the late Sir Frederick Pickworth it is announced that the **Viscount Knollys,** G.C.M.G., M.B.E., D.F.C., Chairman of Vickers Limited, has been elected chairman of the English Steel Corporation.

At the annual general meeting of the Production Engineering Research Association **Sir William Stanier,** F.R.S. was re-elected President of the Association, and at the recent meeting of

Sir Basil Tangye

the Council of the association **Sir Basil R. G. Tangye,** Bt., M.I.Mech.E., was elected chairman of the Council in succession to **Sir Lionel Kearns,** C.B.E., who remains a member of the Council and of the executive committee of the association.

Head of the Welding Processes Section of the British Welding Research Association **Mr. A. A. Smith,** B.Sc., A.I.M., has been temporarily seconded by the association to the Department of Scientific and Industrial Research for attachment to the staff of the United Kingdom Scientific Mission in Washington, U.S.A.

It has been announced by the Institution of Production Engineers that the Council has elected **Mr. G. Ronald Pryor** as President of the Institution for the year 1959/60. The present Chairman of the Council, **Mr. H. W. Bowen,** O.B.E., has been re-elected to that position for a further year of office and **Mr. R. H. S. Turner,** M.A., has been re-elected Vice-Chairman of the Council.

Professor of Inorganic and Physical Chemistry at the University of Melbourne, Australia, **Dr. J. S. Anderson,** M.Sc., Ph.D., F.R.S., has been appointed Director of the National Chemical Laboratory, of the Department of Scientific and Industrial Research, and will be taking up his new duties in October next.

Various organizational changes recently took place in The Mond Nickel Company Limited and its subsidiary company, Henry Wiggin and Company Limited. The changes are as follows:—**Mr. L. H. Cooper** relinquishes his positions as Chairman and Director of both companies; **Mr. G. Archer** becomes Chairman of both companies succeeding Mr. Cooper in these capacities; three Managing Directors of the Mond company are appointed—**Mr. I. A. Bailey** (Operations), **Dr. L. B. Pfeil** (Research and Technical), and **Mr. J. O. Hitchcock** (Commercial); Mr. Bailey will continue as Managing Director of the Wiggin company, and Dr. Pfeil and Mr. Hitchcock continue as directors of that company. **Dr. A. G. Ramsay** becomes a director of Wiggin and continues as the director of Mond resident at Clydach; **Mr. F. Dickinson** becomes a director of Mond and continues as Manager of the Development and Research department of Mond; **Mr. F. B. H. Howard-White** and **Mr. R. A. R. Hill** relinquish their respective positions as Secretary and Comptroller of Mond and Wiggin and continue as directors of both companies; **Mr. E. Vaughan** and **Mr. D. Parry Davies** become Secretary and Comptroller respectively of both Mond and Wiggin, and **Mr. C. W. R. Edwards** becomes Chief Legal Officer of Mond and Wiggin and continues as assistant secretary of both companies.

News from The Bronx Engineering Company Limited is that **Mr. F. Cartwright** has been appointed project engineer for the company. He is a

Mr. F. Cartwright

specialist in all types of metal working machinery including slitting lines, tube straightening machines and specialist plant for aluminium and steel works.

At the July meeting of The Institute of Physics the following were elected Fellows of the Institute:—**Mr. J. C. Bell, Mr. S. I. Evans, Mr. C. G. Giles, Mr. A. E. Hawkins, Mr. C. A. Haywood, Mr. G. W. Nederbragt, Mr. R. L. Russell, Mr. C. A. Wass,** and **Mr. A. E. Widdowson.** In addition 53 associates were elected, 29 graduates, 14 students and 4 subscribers.

Finance director of Yorkshire Imperial Metals Limited at Leeds, **Mr. T. Crompton** has been elected to the board of Yorkshire Copper Works (Holdings) Limited.

Formerly production manager at the Chester works of Brookhirst Igranic, **Mr. P. B. Forrest** has been appointed works manager of Fawcett Preston and Company Limited. Both companies are members of the Metal Industries Limited group.

At the annual general meeting of the British Non-Ferrous Metals Federation held in Birmingham **Mr. W. W. Dolton** (The Delta Metal Company, Limited), was elected President for the ensuing year. **Dr. Maurice Cook,** C.B.E., (Imperial Chemical Industries

Mr. W. W. Dolton

Limited), **Mr. W. F. Slater** (Thomas Bolton and Sons Limited), and **Mr. Michael Clapham** (Yorkshire Imperial Metals Limited), were re-elected Vice-Presidents. **Mr. C. H. M. Holden** (Charles Clifford Limited) was also elected a Vice-President.

At the annual general meeting of the Institute of Physics held in London **Sir George Thomson** (Master of Corpus Christi College, Cambridge) was re-elected President. **Dr. J. M. A. Lenihan** was elected a Vice-President.

News from British Insulated Callender's Construction Company, Limited is that **Mr. J. N. Gibson, Mr. J. R. McDonald,** B.Sc., A.M.I.E.E., and **Mr. D. M. H. Rooney,** M.A., A.M.I.E.E., have been appointed executive directors of the company as from June 1 last.

It is announced by Steele and Cowlishaw Limited that **Mr. R. G. Baines** has been appointed area sales manager for the southern region of England. He will operate from the company's London office.

A new appointment has been announced by Albright and Wilson Limited. **Sir Owen Wansbrough-Jones,** K.B.E., C.B., M.A., Ph.D., F.R.I.C., is to be a full-time director of the company as from October 1 next.

In order to improve service to customers all products of the engineering divisions of Geo. Salter and Company Limited, are to be combined under one sales manager. He is **Mr. G. Rushton,** and his responsibilities now include springs and castings as well as retainers, fasteners and roller bearings for which he was previously sales manager. At the same time,

Mr. W. A. Whitehouse, hitherto Midland area manager for the company, has been appointed sales controller (engineering divisions) while a new representative **Mr. J. M. Hipkins** is taking over the Birmingham, Warwick and Oxford areas. In Scotland and the Border counties the company has appointed **Mr. Wm. M. Stewart** as technical manager for engineering products.

On reaching retirement age **Mr. Ernest Crosse** relinquished his position as Executive Director of J. Brockhouse and Company Limited on June 30 last.

Purchasing director of Joseph Lucas (Electrical) Limited, **Mr. W. I. Shaw** has been appointed Chairman of the Birmingham branch of the Purchasing Officer's Association. **Mr. R. C. Woodward,** of the Francis Williams Oil Company Limited, has been appointed Vice-Chairman.

It is announced that **Mr. R. O. Barnett** and **Mr. R. Diamond** have been appointed directors of Coley Metals.

Elected President of the Institute of Welding for 1959/60 **Mr. F. Seymour-Semper,** M.I.Mech.E., is a director of Hancock and Company (Engineers) Limited. Elected as Vice-Presidents of the Institute are **Mr. W. Barr,** O.B.E., A.R.T.C., (chief metallurgist of Colvilles Limited), and **Mr. E. Fuchs,** M.A., A.M.I.Mech.E., (welding engineer of Imperial Chemical Industries Limited, Alkali Division).

Inauguration of the new President, **Mr. L. A. Woodhead** (Cossor Instruments Limited), was the feature of the annual general meeting of the Scientific Instrument Manufacturers' Association of Great Britain, which was held in London early last month.

A new appointment made by Carbide Industries, a member of the British Oxygen Group, is that of **Mr. E. H. Curtis** as general manager.

New appointments have been announced by member firms of the Sheepbridge Engineering Group. A new technical representative for the South-West of England and the South Wales areas has been appointed by Sheepbridge Stokes Limited. This is **Mr. Michael E. Southway** who will be located in Bristol. Advance Motor Supplies Limited announce that **Mr. L. U. Garroch** is now manager of their branch establishment at Argyle Street, Glasgow.

It has been announced by the British Transport Commission that **Mr. John Dearden,** assistant superintendent (Metallurgy Division) British Railways Research Department, Derby, has been appointed superintendent of the Metallurgy Division in place of **Mr. T. Henry Turner,** who has retired.

Market Review

IN the following review of the non-ferrous metal markets for the past seven weeks an attempt is made to summarize the position of the metals each week and so to enable readers to possess some continuity of the market for those weeks in which this journal has been unable to appear.

Copper

At the end of June the price of standard copper suffered a setback and this was said to be due to an increase in refined stocks in the U.S.A. while there was also an increase in stocks in the official warehouses of the London Metal Exchange. The opening days of July saw the copper market faced with the prospects of a strike although the men were continuing to work pending the result of a vote to be taken by the end of the first week in the month. At this time the metal closed at £221 5s. 0d. cash and £222 5s. 0d. three months, after a turnover of about 13,000 tons. The second week in July was not a particularly good period for holders on any non-ferrous metals with the exception of zinc. As far as copper was concerned it seemed that the great bull market on the New York commodity exchange was split wide open through a spate of stopless selling by operators apparently unable to face up to the financing of positions that had very definitely gone stale on them. By the middle of July the market took a big jump, the upward movement being touched off by the news that Phelps Dodge intended to cut production by 7 per cent. Moreover the June statistics were, on the face of it, favourable and probably better than anticipated. By the end of July the market seemed to have entered a relatively calm period. At the end of the last week cash stood at £224 10s. 0d. and three months at £225 5s. 0d. Coming to the opening days of August there was little change noticeable in copper. The market was subjected to various reports about strikes and threats of stoppages in the U.S.A. and elsewhere but on the whole London showed itself to be the steadier market of the two.

Tin

During the latter days of June and the opening of July, trading in tin was not very active and the turnover was rather below average at 610 tons. The tone was steady and when, in the first week in July the Board of Trade announced that it was proposed to sell some 2,500 tons of U.K. stockpile through the Buffer Stock manager, little effect was noticeable in the price level although the quotation did lose ground initially. At the end of that week cash price stood at £791 10s. 0d. and forward at £793. Prices continued to be well maintained during the following days although in general outside demand has been fairly quiet. At the time of writing cash is being paid at £793 and three months at £790 10s. 0d. For the last week in July the turnover was about 765 tons. With the re-opening of the market after the Bank Holiday week-end moderate dealings at steady prices were the rule.

Zinc

In the past three months zinc prices have risen by around £8 to top £82 per ton which is about the best level for some long time. Much of the market's recuperative powers are traceable to the decisions taken at the United Nations zinc and lead conference in New York in May last. World consumption on the metal seems to have improved since that meeting. Special high grade zinc for die-casting purposes is in sustained request. At the end of June the L.M.E. price was £79 2s. 6d. cash and £77 17s. 6d. forward. During the first few days in July cash price was £80 12s. 6d. and forward £79 5s. 0d. In the second week in July turnover of this metal was in the nature of 6,150 tons closing at £80 5s. 0d. and £79 5s. 0d. forward. By mid-July prices and turnover were virtually unchanged and at the end of the month the turnover was 5,600 tons for the week with prices at £80 15s. 0d. cash and £80 2s. 6d. forward. By the beginning of August these prices had risen to £82 15s. 0d. cash and £81 12s. 6d. forward.

Lead

After a weak ending in June lead showed a slight improvement during the early days of July and at the end of the first week after a turnover of about 6,000 tons, the price recovered to £70 cash and £71 5s. 0d. forward. In the second week of the month some 7,275 tons changed hands with a lowering of prices at £69 5s. 0d. cash and £70 10s. 0d. forward. The position recovered slightly the following week with prices 30s. and 15s. better respectively and a turnover of 9,150 tons. The month finished with a turnover of 9,000 tons and prices at £70 17s. 6d. cash and £71 5s. 0d. forward. For the opening days of August some 6,000 tons of lead changed hands with a loss of 17s. 6d. on cash price while forward was unchanged at £71 5s. 0d. At the time of writing the cash price stands at £70 5s. 0d. with forward still unchanged.

Metal Market News

LAST week flew a bullish flag on the Metal Exchange during the four days of trading, and gains were registered by all the metals except tin, which closed virtually unchanged. A fresh outburst of optimism on the London Stock Exchange sent prices ahead, much of this good feeling being due to the greatly improved international outlook as a result of the projected visits between Russia and the United States. It is significant, perhaps, that Defence stocks closed lower on Wall Street last week. Unfortunately, the "good news" for bulls of copper consisted of reports that the copper strike, originally scheduled for July 1, was very likely to take place. Initially, the standard copper market declined on information that Kennecott had made an offer to the Steelworkers' Union, but subsequently this offer was rejected. Apart from strike news came a report that the Chileans were toying with the idea of a cutback in production and this, of course, helped the market. On the other hand, moderating news came from the Anglo-American interests in Northern Rhodesia, where, so far, there is no indication or hint of a reduction in production and a fairly clear intimation that an unduly high price for electrolytic copper is not desirable. Consumers will be heartily in favour of this sentiment, for in the past they have suffered too much from inflated copper values to be anything but apprehensive about last week's developments. Already there has been talk of copper at £240, and from their experience of the market, users have good reason to fear that if and when £240 is reached the quotation will be talked up to £250.

Probably there are few consumers of copper in this country who are convinced that they would be better off under a system of "managed prices," but they do heartily deplore and dislike the erratic alterations in value seen in Whittington Avenue. The trouble is that majority opinion lays the blame for this state of affairs at the door of the Metal Exchange, whereas it is, of course, the ever-changing pattern of events which causes fluctuations in value. At the present time there are strikes in being and strikes in prospect. There are also production cuts already made and those which are still in the threatening stage. In other words, it is events in the industry itself which compel the ebb and flow in sentiment, which in turn affects the quotation on the free market in London. The counterpart of Whittington Avenue in New York is, of course, the Commodity Exchange, where considerable price variations occur.

Stocks of standard copper in L.M.E. warehouses fell by 382 tons to 14,966 tons at the beginning of last week. Trading began only on Tuesday and the turnover, with Kerb dealing, approached 10,000 tons. Initially, values eased on Kennecott's reported offer to the Steelworkers' Union, which was, however, subsequently rejected. Thereafter the trend was upwards, a feature being the strength of the Kerb markets on Friday and Wednesday. Friday also brought a rise of 50 points in the custom smelters' price to 30 cents. Bidding for the cash position increased the backwardation to £2 10s. 0d., quotations at the close being £232 5s. 0d. prompt and £229 15s. 0d. forward. Gains on the week of £6 15s. 0d. for cash and £4 10s. 0d. three months were recorded. Stocks of tin rose by 139 tons to 8,718 tons, the only change in value being a loss of 10s. for cash to £793. The turnover was 520 tons. About 7,650 tons of lead changed hands, with a gain of 30s. in August to £71 10s. 0d. and of 17s. 6d. in November to £72 2s. 6d. Zinc was strong, closing 30s. up August at £84 5s. 0d. and 27s. 6d. better for November at £83. About 5,650 tons were traded.

India

According to reports from Madras the Italian Monte Catini firm, appointed by the Madras government to estimate the quantity and aluminium content of bauxite available in Salem district, has found the ore suitable for the manufacture of aluminium. The experts have already submitted their report to the state government. They are understood to have expressed the opinion that the quantity of bauxite available in the district would be over two million tons and that the grade was between 39 and 44 per cent. The bauxite would last, according to the experts, for 25 to 30 years for a 10,000-ton aluminium plant and 16 to 18 years for a 20,000-ton plant. A 10,000-ton aluminium manufacturing plant was estimated to cost 100 million rupees.

A committee of industrialists in the state, headed by Mr. R. Venkataswamy Maidu, former Chairman of the Southern India Millowners' Association, Coimbatore, is said to be engaged in taking steps for the establishment of an aluminium manufacturing industry in the Salem district.

New York

Week-end news was that Commodity Exchange copper after early firmness lost most of the gain on profit-taking in a thin trading volume. Traders said early buying had developed on the news that the United Steelworkers' Union had notified Kennecott that its members might strike on August 10 if no agreement on a new contract was reached by then. The Mine Mill Union national wage policy committee was still meeting in Denver to discuss possible strike action against the non-ferrous metal industry. Meanwhile, in physical copper custom smelters reported slow conditions but at least one leading producer indicated some improvement in sales. Tin was quiet and steady. Lead and zinc were moderately active.

It is reported that Beryllium Corporation said it has completed expansion of its beryllium metal fabrication division at Hazleton, Pennsylvania, adding two new vacuum hot press furnaces to the single furnace previously operating. Mr. Lawrence F. Boland, vice-president of the concern, said the expansion was needed to meet increased demand for beryllium metal components from aircraft, missile and nuclear users. The new units will allow production of beryllium metal pieces from six inches up to about 45 inches in diameter by 60 inches long. One of the new furnaces is designed for continuous production of extrusion billets, the company said. The cost of the project was not disclosed.

Birmingham

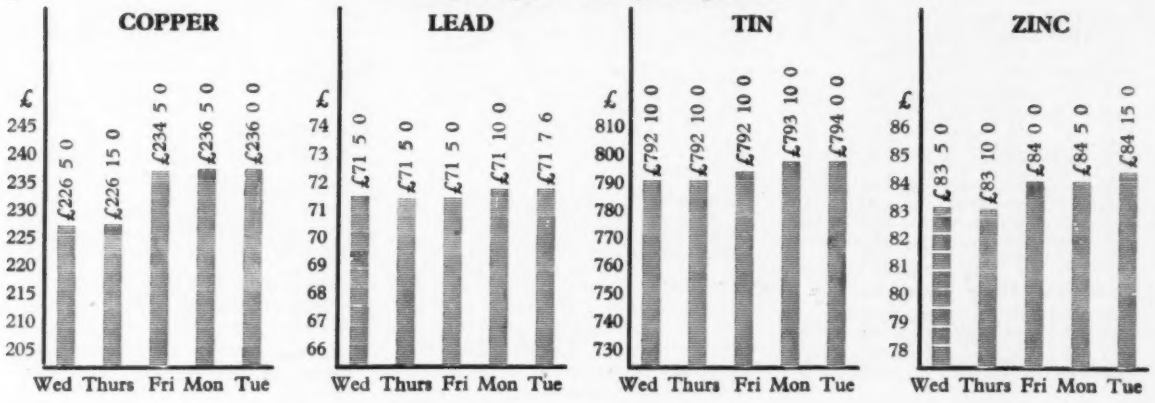
Works re-opened this week after the fortnight's industrial holiday, but trading conditions are likely to continue quiet throughout August. Once more the motor trade is in the throes of an industrial dispute, and unless an early settlement can be achieved a serious drop in output must result. Apart from this consideration, the outlook for the metal-using industries is much improved. Unemployment reached its peak two or three months ago and is now declining steadily. There are more vacancies in the metal and engineering industries than has been the case for a long time. Steady recovery is being helped by an effort on the part of manufacturers to keep prices round about their present level.

The steel outlook continues to improve, particularly in relation to the lighter products, and it is believed that output will show a gradual rise from September to the end of the year. Imports are negligible now that British steelworks can supply raw materials promptly. Pig iron production is adequate for the needs of the foundries, although substantial improvement has taken place in the demand for both light and heavy castings. More steel is being used in the mechanical and electrical engineering industries than at this time last year. Demand for heavy steel products lags behind in the recovery, with new business coming in only slowly. The heavy stocks of iron and steel which existed early in the year have been reduced substantially.

Non-Ferrous Metal Prices

London Metal Exchange

Wednesday 5 August to Tuesday 11 August 1959



Primary Metals

All prices quoted are those available at 2 p.m. 11/8/59

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite per unit			—	
Copper H.C. Electro	ton	236	0	0
Fire Refined 99·70%	„	235	0	0
Fire Refined 99·50%	„	234	0	0

		£	s.	d.
Copper Sulphate	ton	74	10	0
Germanium	grm.		—	
Gold	oz.	12	9	10
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	71	7	6
Magnesium Ingots	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	74	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	7	5	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	6⅞
Tellurium	lb.		15	0
Tin	ton	794	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	83	16	3
Dust 95/97%	„	109	0	0
Dust 98/99%	„	115	0	0
Granulated 99+%	„	108	16	3
Granulated 99·99+%	„	122	10	0

**Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏£/ton	Canada c/lb ≏£/ton	France fr/kg ≏£/ton	Italy lire/kg ≏£/ton	Switzerland fr/kg ≏£/ton	United States c/lb ≏£/ton
Aluminium		22.50 185 17 6	224 165 0	375 221 5	2.50 212 10	26.80 214 10
Antimony 99.0			220 163 0	445 262 10		29.00 232 0
Cadmium			1,300 975 0			120.00 960 0
Copper						
Crude						
Wire bars 99.9				445 262 12 6		
Electrolytic	31.00 228 5 0	29.00 238 12 6	312 234 0		2.80 238 0	30.00 240 0
Lead		10.25 84 12 6	105 78 15	163 96 2 6	,88 74 17 6	12.00 96 0
Magnesium						
Nickel		70.00 578 5	900 675 0	1,200 708 0	7.50 637 10	74.00 592 0
Tin	111.50 820 12 6		1,129 846 15	1,500 885 0	9.70 824 12 6	101.75 808 0
Zinc						
Prime western		11.50 95 0 0				11.00 88 0
High grade 99.95		12.10 100 0 0				
High grade 99.99		12.50 103 2 6				
Thermic			122.00 91 10			
Electrolytic			130.00 97 10	184 108 12 6	1.02 86 17	12.25 98 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 11/8/59

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10.... „	221	0	0
B.S. 1490 L.M.11.... „	215	0	0
B.S. 1490 L.M.12.... „	223	0	0
B.S. 1490 L.M.13.... „	216	0	0
B.S. 1490 L.M.14.... „	224	0	0
B.S. 1490 L.M.15.... „	210	0	0
B.S. 1490 L.M.16.... „	206	0	0
B.S. 1490 L.M.18.... „	203	0	0
B.S. 1490 L.M.22.... „	210	0	0
†Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	153	0	0
B.S. 1490 L.M.2 .... „	163	0	0
B.S. 1490 L.M.4 .... „	178	0	0
B.S. 1490 L.M.6 .... „	189	0	0
***Aluminium Bronze**			
BSS 1400 AB.1..... ton		—	
BSS 1400 AB.2..... „		—	

*Brass	£	s.	d.
BSS 1400-B3 65/35 .. ton		—	
BSS 249 ..... „		—	
BSS 1400-B6 85/15 .. „		—	
***Gunmetal**			
R.C.H. 3/4% ton .... „		—	
(85/5/5/5) LG2 ..... „		—	
(86/7/5/2) LG3 ..... „		—	
(88/10/2/1) ..... „		—	
(88/10/2/½) ..... „		—	
***Manganese Bronze**			
BSS 1400 HTB1.... „		—	
BSS 1400 HTB2.... „		—	
BSS 1400 HTB3.... „		—	
Nickel Silver			
Casting Quality 12% „	220	0	0
„ „ 16% „	230	0	0
„ „ 18% „	235	0	0
***Phosphor Bronze**			
B.S. 1400 P.B.1.(A.I.D. released) ..... „		—	
B.S. 1400 L.P.B.1 .... „		—	

** Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10% ..... ton	246	0	0
15% ..... „	248	0	0
Phosphor Tin			
5% ..... „		—	
Silicon Bronze			
BSS 1400-SB1 ..... „	241	0	0
Solder, soft, BSS 219			
Grade C Tinmans.... „	369	0	0
Grade D Plumbers.. „	297	0	0
Grade M ..... „	405	3	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „		—	
Zinc Alloys			
Mazak III ..... ton	115	15	0
Mazak V ..... „	119	15	0
Kayem ..... „	125	15	0
Kayem II ..... „	131	15	0
Sodium-Zinc ..... lb.		2	7

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium			
Sheet 10 S.W.G. lb.		2	8½
Sheet 18 S.W.G. „		2	10½
Sheet 24 S.W.G. „		3	1½
Strip 10 S.W.G. „		2	8½
Strip 18 S.W.G. „		2	9½
Strip 24 S.W.G. „		2	11
Circles 22 S.W.G. „		3	2½
Circles 18 S.W.G. „		3	1½
Circles 12 S.W.G. „		3	0½
Plate as rolled ..... „		2	8
Sections ..... „		3	2
Wire 10 S.W.G. .... „		2	11½
Tubes 1 in. o.d. 16 S.W.G. ..... „		4	1
Aluminium Alloys			
BS1470. HS10W.			
Sheet 10 S.W.G. „		3	1
Sheet 18 S.W.G. „		3	3½
Sheet 24 S.W.G. „		3	11
Strip 10 S.W.G. „		3	1
Strip 18 S.W.G. „		3	2½
Strip 24 S.W.G. „		3	10½
BS1477. HP30M.			
Plate as rolled..... „		2	11
BS1470. HC15WP.			
Sheet 10 S.W.G. „		3	9½
Sheet 18 S.W.G. „		4	2
Sheet 24 S.W.G. „		5	0½
Strip 10 S.W.G. „		3	10½
Strip 18 S.W.G. „		4	2
Strip 24 S.W.G. „		4	9½
BS1477. HPC15WP.			
Plate heat treated.. „		3	6½
BS1475. HG10W.			
Wire 10 S.W.G. „		3	10½
BS1471. HT10WP.			
Tubes 1 in. o.d. 16 S.W.G. ..... „		5	0½
BS1476. HE10WP.			
Sections ..... „		3	1½
Brass			
Tubes..... „		1	10½
Brazed Tubes..... „		3	0½
Drawn Strip Sections „		—	
Sheet ..... ton	202	10	0
Strip ..... „	202	10	0
Extruded Bar..... lb.		2	0½
Extruded Bar (Pure Metal Basis) ..... „		—	

Brass		£	s.	d.
Condenser Plate (Yellow Metal).....	ton	187	0	0
Condenser Plate (Naval Brass)	„	199	0	0
Wire	lb.		2	8½
Beryllium Copper				
Strip	„	1	4	11
Rod.....	„	1	1	6
Wire	„	1	4	9
Copper				
Tubes	lb.		2	3½
Sheet	ton	265	5	0
Strip	„	265	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	278	15	0
Cupro Nickel				
Tubes 70/30	lb.		3	6¼

Lead				
Pipes (London)	ton	111	5	0
Sheet (London)	„	109	0	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7% ..	lb.		3	7¾
Wire 10%	„		4	2½
Phosphor Bronze				
Wire	„		4	1½
Titanium (1,000 lb. lots)				
Billet 4½″ to 18″ dia...	lb.	54/-		55/-
Rod ¼″ to 4″ dia.	„	95/-		62/-
Wire ·036″ – ·232″ dia.	„	167/-		110/-
Strip ·003″ to ·048″ ..	„	200/-		75/-
Sheet 8′×2′. 20 gauge	„	85/-		
Tube, representative average gauge.....	„	300/-		
Extrusions	„	105/-		
Zinc				
Sheet ..... ton		119	5	0
Strip ..... „		nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 11/8/59.

Aluminium	£
New Cuttings	145
Old Rolled	126
Segregated Turnings	98
Brass	
Cuttings	161
Rod Ends	148
Heavy Yellow	118
Light	124
Rolled	153
Collected Scrap	120
Turnings	143
Copper	
Wire	215
Firebox, cut up	209
Heavy	205
Light	199
Cuttings	215
Turnings	198
Braziery	160

Gunmetal	£
Gear Wheels	178
Admiralty.....	178
Commercial	157
Turnings	152
Lead	
Scrap	60
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	157
Turnings	152
Zinc	
Remelted	70
Cuttings	56
Old Zinc	38

Financial News

I.C.I. and Alcoa

It was announced in London recently that Imperial Chemical Industries Ltd. have entered into agreement with the Aluminum Company of America to collaborate in manufacturing wrought aluminium products. The two companies propose, the consent of the Treasury having been obtained, to establish a new company named Imperial Aluminium Company Limited, to which I.C.I.'s aluminium plants at Waunarllwynd (Glam.) will be transferred.

I.C.I. will hold 51 per cent and Alcoa 49 per cent of the capital of the new company, and I.C.I. will appoint three of the five directors, including the chairman and managing director. Control will remain in British hands. Alcoa, announcing the agreement in Pittsburg, said Imperial Aluminium was expected to begin operations by August 1.

Johnson, Matthey and Co. Ltd.

Group profit £1,455,909 (£1,724,325), net profit £828,282 (£934,492). Dividend recommended of 12 per cent. It is also proposed to capitalize £2m. of reserves in a one-for-two scrip issue.

Metal Products Co. (Willenhall)

Trading profit shown at £89,443 (£80,899), net profit at £38,490 (£29,191).

Zinc Alloy Rust-Proofing Co.

Consolidated profit for year ended April 30, 1959, £80,514 (£91,832). Recommended dividend of 30 per cent.

London Aluminium

Group net profit, 1958, is £46,711 (£38,194), and dividend 10 per cent (same), as stated June 18. Fixed assets £343,625 (£351,477), trade investments £124,615 (£109,935), and current assets £739,732 (£753,447). Liabilities, £357,501 (£381,233).

A. Cohen and Co.

Final dividend 16½ per cent making 22½ per cent for 1958 (same). Group net profit £102,375 (£111,961), after tax of £42,708 (£50,803). Available for parent £93,364 (£100,916).

The Mint, Birmingham

Net profit year to March 31, 1959, is £31,129 (£3,022) after tax £25,162 (£18,784). Ordinary distribution 10 per cent (same). Net current assets £329,064 (£347,298). Government and other securities £58,499 (same), market value £44,008 (£40,952). Commitments £27,500 (£46,500).

A. E. Griffiths (Smethwick)

Group net profit year to March 31, 1959 £27,958 (£61,404), and dividends 22½ per cent (same). Current assets £182,079 (£245,762), and liabilities £72,735 (£107,637).

Morgan Crucible Co. Ltd.

Group profit, before tax, year ended March 29, 1959, £1,720,798 (£1,901,479), dividend 12 per cent (10 per cent) and capital distribution of 3d. per £1 unit. Net current assets £6,145,823 (£5,911,632). Capital employed £15,499,075 (£13,246,424). Capital commitments £162,000 (£201,000).

Firth Brown Tools

Net profit year ended March 31, 1959, £174,498 (£161,697), after depreciation £137,623 (£145,634) and tax £188,856 (£238,439). Dividend 9 per cent (same). Fixed asset replacement reserve £50,000 (same).

Capper Pass and Son

Second interim dividend 3 per cent (same) and a final of 3 per cent (2 per cent), making 10 per cent for year to March 31, 1959 (8 per cent). Group net profit £208,301 (£26,932), after tax £243,502 (£120,125). To market reserve £65,000 (from market reserve £170,000).

Spanish Tax Cut

In an official Bulletin issued in Madrid it is announced that tax on aluminium ingot and waste imports is cut to 0.72 gold pesetas from 1·25 previously.

Keith Blackman

Dividend of 17½ per cent year to March 31, 1959 (same). During year Ordinary holders have received a 50 per cent scrip issue in 7 per cent Second Preference. Subject to audit, net profit £134,984 (£192,153), after tax £211,393 (£232,850). Add transfer from provision for contract contingencies £60,633 (nil). To general reserve £100,000 (£75,000), to pensions reserve £15,000 (nil). Forward £195,792 (£188,831).

Light Metal Statistics

Figures showing the U.K. production, etc., of light metals for March, 1959, have been issued by the Ministry of Supply as follows (in long tons):—

Virgin Aluminium	
Production	1,963
Imports	22,131
Despatches to consumers	22,799
Secondary Aluminium	
Production	8,820
Virgin content of above	926
Despatches (including virgin content)	9,029
Scrap	
Arisings	11,852
Estimated quantity of metal recoverable	8,366
Consumption by:	
(a) Secondary smelters	10,928
(b) Other uses	951
Despatches of wrought and cast products	
Sheet, strip and circles	11,888
Extrusions (excluding forging bar, wire-drawing rod and tube shell):	
(a) Bars and sections	2,668
(b) Tubes (i) extruded	161
(ii) cold drawn	463
(c) (i) Wire	1,775
(ii) Hot rolled rod (not included in (c) (i)	478
Forgings	301
Castings: (a) Sand	1,445
(b) Gravity die	3,801
(c) Pressure die	1,593
Foil	1,899
Paste	240
Magnesium Fabrication	
Sheet and strip	3
Extrusions	46
Castings	145
Forgings	5

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£197.10.0)	225
Heavy copper	(£197.10.0)	225
Light copper	(£166.12.6)	190
Heavy brass	(£113.17.6)	130
Light brass	(£87.15.0)	100
Soft lead scrap	(£56.0.0)	64
Zinc scrap	(£38.12.6)	44
Used aluminium unsorted	(£87.15.0)	100
France (francs per kilo):		
Electrolytic copper scrap	(£187.12.6)	250
Heavy copper	(£187.12.6)	250
No. 1 copper wire	(£172.12.6)	230
Light brass	(£122.0.0)	160
Zinc castings	(£51.0.0)	68
Lead	(£69.0.0)	92
Aluminium	(£129.12.6)	173
Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£200.15.0)	340
Aluminium copper alloy	(£132.17.6)	225
Lead, soft, first quality	(£75.12.6)	128
Lead, battery plates	(£41.17.6)	71
Copper, first grade	(£215.10.0)	365
Copper, second grade	(£203.2.6)	345
Bronze, first quality machinery	(£197.5.0)	335
Bronze, commercial gunmetal	(£170.2.6)	285
Brass, heavy	(£138.15.0)	235
Brass, light	(£126.17.6)	215
Brass, bar turnings	(£132.17.6)	225
New zinc sheet clippings	(£65.0.0)	110
Old zinc	(£50.2.6)	85

LIGHT METALS STATISTICS IN JAPAN

(February, 1959)

Classification	Production	Shipment	Stock	Export
Alumina	21,864	24,022	15,234	9,270
Aluminium				
Primary	6,748	7,501	2,949	0
Secondary	2,316	2,287	343	0
Rolled Products	6,884	6,801	1,924	698
Electric Wire	1,097	1,020	548	324
Sheet Products	1,624	1,576	1,131	87
Castings	2,016	—	—	—
Die-Castings	1,101	—	—	—
Forgings	24	—	—	—
Powder	—	—	—	—
Primary Aluminium (March)	7,894	8,484	2,359	102
Sponge Titanium	165	—	—	114
Magnesium	107	111	49	0
Secondary	199	278	241	0

THE STOCK EXCHANGE

Markets Easier Following Sustained Strength And Activity. Steels Reflect Considerable Demand

ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 10 AUGUST	+RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	26/3	+1/6	9	9	6 17 3	27/4½	23/3	24/9	17/6
400,000	2/–	Anti-Attrition Metal	1/3		4	8½	6 15 0	1/6	1/3	1/9	1/3
41,303,829	Stk. (£1)	Associated Electrical Industries ...	63/6	+7/-	15	15	4 14 6	63/6	54/–	58/9	46/6
1,613,280	1	Birfield	58/-	+6d.	15	15	5 3 6	59/4½	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	81/–	+1/3	17½	17½	4 6 6	81/10½	72/–	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	45/–	+9d.	11	10	4 17 9	48/3	36/1½	39/–	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/6		5	5	6 9 0	16/3	15/–	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	18/10½		6	6	6 7 0	18/10½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	34/–		10	10	5 17 9	34/–	27/6	28/9	24/–
300,000	1	Ditto Pref. 5%	15/3		5	5	6 11 3	15/6	14/–	16/–	15/–
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6		7	7	6 16 6	20/6	20/–	20/4½	19/–
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	20/3	+3d.	6	6	5 18 6	20/3	18/9	20/–	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	51/6	+6d.	12½	12½	4 17 0	57/–	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	65/–	+2/–	10	10	3 1 6	65/–	49/3	52/–	28/3
1,200,000	Stk. (5/–)	Canning (W.) & Co.	14/6		25+*2½C‡	25	4 6 3	16/–	12/3	25/3	19/3
60,484	1/–	Carr (Chas.)	2/6		12½	25	5 0 0	2/7½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	24/9		10	10	8 1 6	24/9	22/6	22/–	16/–
45,000	1	Ditto Cum. Pref. 6%	16/9		6	6	7 3 3	16/9	15/3	16/–	15/–
250,000	2/–	Coley Metals	3/–		15	20	10 0 0	4/–	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	66/6	—3d.	15	18‡	4 10 3	69/3	59/–	65/3	41/–
1,509,528	1	Davy & United	68/9	+1/3	30‡	20	4 7 3	70/–	43/1½	87/–	45/9
6,840,000	5/–	Delta Metal	17/–	+9d.	31‡	30	4 11 3	17/9	12/–	25/–	17/7½
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	53/–	+3d.	15	12½	5 13 3	57/6	36/7½	38/–	22/9
750,000	1	Evered & Co.	35/9		10§	15 Z	5 12 0	35/9	30/–	30/–	26/
18,000,000	Stk. (£1)	General Electric Co.	37/6	+9d.	10	10P	5 6 9	40/3	30/–	40/6	29/6
1,500,000	Stk. (10/–)	General Refractories Ltd.	34/6		20	20	5 16 0	40/–	32/6	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	64/–		16½	15	5 3 0	66/6	63/6	67/6	61/–
750,000	5/–	Glacier Metal Co. Ltd.	8/–		11½	11½	7 3 9	9/3	6/7½	8/3	5/–
1,750,000	5/–	Glynwed Tubes	21/6		20	20	4 13 0	22/9	16/4½	18/1½	12/10½
3,421,049	10/–	Goodlass Wall & Lead Industries ...	38/6		13‖	18Z	3 7 6	38/9	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	108/3		30	20	5 11 0	108/3	75/–	57/9	45/–
396,000	5/–	Harrison (B'ham) Ord.	19/3	+3d.	*17½	*15	4 10 9	19/3	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/3		7	7	7 5 6	—	—	19/9	18/4½
1,075,167	5/–	Heenan Group	9/9	+1/3	10	10‡	5 2 6	9/9	7/6	9/7½	6/9
236,958,260	Stk. (£1)	Imperial Chemical Industries ...	38/6	+1/6	12Z	10	4 3 0	38/7½	33/9	38/–	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	17/9	+3d.	5	5	5 12 9	17/9	16/–	17/1½	16/–
14,584,025	••	International Nickel	187	—‡	$2.60	$3.75	2 10 6	187‡	154½	169	132‡
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	15/9		5	5	6 7 0	16/3	15/4½	16/9	15/–
6,000,000	1	Ditto Ord.	38/3	—9d.	12D	10	4 3 9	42/–	29/7½	47/–	36/6
600,000	10/–	Keith, Blackman	30/–		17½E	15	5 16 9	30/–	25/–	28/9	15/–
320,000	4/–	London Aluminium	5/10½	—4½d.	10	10	6 16 3	6/9	5/3	6/–	3/–
765,012	1	McKechnie Brothers Ord.	42/6		15	15	7 1 3	45/–	41/3	45/–	32/–
1,530,024	1	Ditto A Ord.	41/3		15	15	7 5 6	43/6	38/9	45/–	30/–
1,108,268	5/–	Manganese Bronze & Brass	14/3	+3d.	20§	20	7 6 3	16/3	13/9	14/1½	8/9
50,628	6/–	Ditto (7½% N.C. Pref.)	6/–		7½	7½	7 10 0	—	—	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	54/3	+1/9	11	11	4 1 3	60/4½	44/7½	73/3	40/6
415,760	Stk. (2/–)	Metal Traders	10/9	+6d.	50	50	9 6 0	10/9	8/4½	9/–	6/3
160,000	1	Mint (The) Birmingham	26/6		10	10	7 11 0	26/6	22/–	22/9	19/–
80,000	5	Ditto Pref. 6%	70/–		6	6	8 11 6	75/6	69/–	83/6	69/–
3,705,670	Stk. (£1)	Morgan Crucible A	54/6	+1/3	10	10	3 13 6	54/6	43/6	45/–	34/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/3		5½	5½	6 0 6	18/6	17/6	18/–	17/–
2,200,000	Stk. (£1)	Murex	50/–	+3/3	15 ·	17½	6 0 0	51/–	41/–	58/9	46/–
468,000	5/–	Ratcliffs (Great Bridge)	11/6	+1½d.	10R	10	3 5 3	11/6	9/6	11/1½	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	40/–		25	20	6 5 0	40/–	27/9	27/3	24/6
1,365,000	Stk. (5/–)	Serck	20/6	+1/–	15	17½	3 13 3	21/–	18/–	18/7½	11/–
6,698,586	Stk. (£1)	Stone-Platt Industries	49/6	+1/–	15	15	6 1 3	53/6	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/3		5½	5½	6 7 6	17/6	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord	88/9	+5/3	17½	15	3 19 0	91/6	72/–	86/–	48/4½
41,000,000	Stk. (£1)	Vickers	31/9	+1/4½	10	10	6 6 0	37/–	29/9	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	14/–		5	5	7 2 9	15/0½	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/–		*5	*5	6 15 3A	22/7½	20/6	23/–	21/3
2,200,000	1	Ward (Thos. W.), Ord.	91/9	+9d.	20	15	4 6 6	97/–	83/–	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	43/–	+6d.	10	10	4 7 0	47/–	39/9	46/6	32/6
225,000	2/–	Wolverhampton Die-Casting ...	10/1½	+3d.	30	25	5 18 6	10/6	8/8½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	27/6	+3d.	27½	27½	5 0 0	31/6	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	7/–	+1½d.	20	20	7 2 9	7/–	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/6		6	6	8 17 9	13/9	13/6	13/–	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/9		27	40D	7 4 0	3/9	2/9	3/1½	2/7½

•Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. ••Shares of no Par Value. ‡ and 100% Capitalized issue. • The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. P Interim dividend since reduced. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units.

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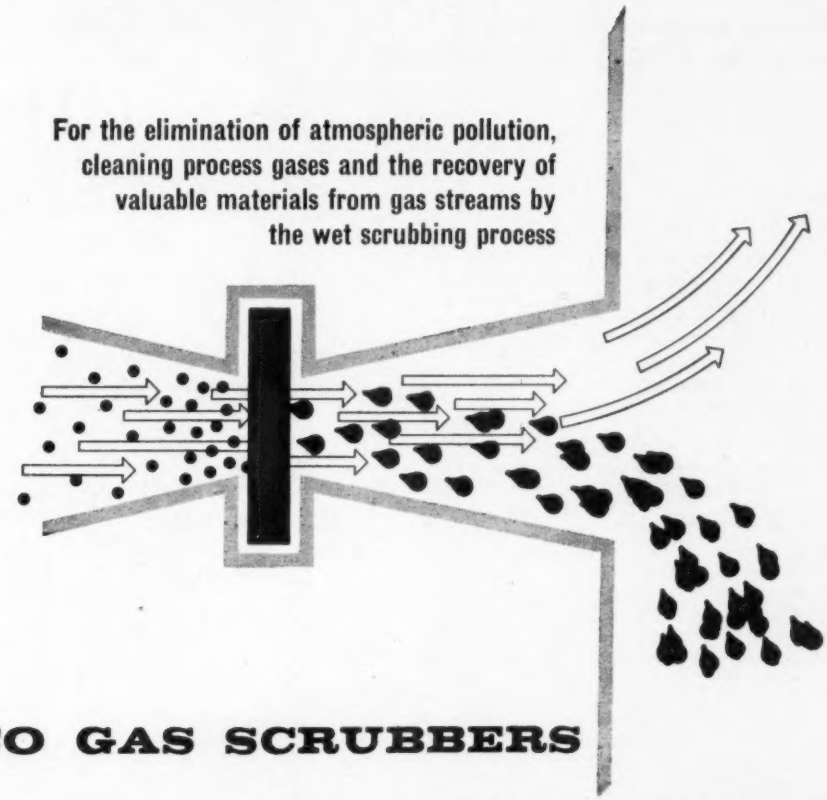

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COMPANY MEETING

THE WOLVERHAMPTON METAL CO.

STRONG FINANCIAL POSITION

MR. THOMAS C. JAMES ON EFFORTS TO INCREASE EFFICIENCY

The 56th annual general meeting of The Wolverhampton Metal Company Limited was held on July 28 in Birmingham. Mr. James H. Furnival (Vice-Chairman and Joint Managing Director) presiding in the unavoidable absence through indisposition of Mr. Thomas C. James (Chairman and Joint Managing Director).

The following is an extract from the Chairman's circulated statement:—

The severe conditions referred to in my last report have continued and intensified. In these circumstances I think that you will agree that the results for the year ended 31st March, 1959, are satisfactory.

Group Profits at £470,215 before taxation compare with £507,119 in the previous year.

In spite of the shortage of raw materials we increased production at Wednesfield (Ingot Metals) and James Bridge (Cathode Copper, etc.) but factors affecting our margins adversely were:—Excess of productive capacity in the industry over the demand for the products, particularly in relation to alloys, resulting in serious price competition; keen competition for the available raw materials and the fall in the level of export prices affecting all producers of ingot metal; business, which had been reasonably profitable in some cases, became uneconomic.

To meet this situation we have been striving, by improving our processing techniques, to reduce costs of production.

Full advantage has been taken of the latest technical developments in the industry including improved laboratory methods. To cope with the much stricter specifications now being developed by the British Standards Committee, we have re-equipped our laboratories with the latest instruments, enabling us to deal with the increased demand for analysis and control and easing the burden on the members of our laboratory staff.

THE ACCOUNTS

I referred in my Statement last year to our Capital Expenditure programme, designed to increase efficiency of production and widen the scope of our activities. During the year under review £112,535 was spent under this heading.

Current Assets at £2,027,392 exceed Current Liabilities at £613,921 by £1,413,471.

After providing £80,784 for depreciation our Group Profit is £470,215. Taxation assessable thereon is £215,915. A result of the reduction in the level of taxation is that our distributable profit exceeds that of last year by £15,159, although the trading profit before taxation is less than in the preceding year by £36,904.

The Board has given careful consideration to the question of dividend. The available profit is some £15,000 higher and the Group has substantial reserves and ample cash resources. At the same time the prospects for the current year are that at present, an increase in profits cannot be anticipated. In these circumstances the Board has decided to recommend that the final dividend be maintained at 17½% less Income Tax making a total of 27½% less Income Tax for the year.

In view of our strong position, however, it has been decided to recommend in addition a special bonus of 5% less Income Tax.

FUTURE OUTLOOK

Current trading conditions indicate that for the time being we shall have to continue to face highly competitive conditions similar to those of the year just ended. In spite of the uncertainty of the metal market and the reluctance of buyers to place orders for forward sales, our order book continues to be satisfactory.

To maintain our position in the forefront of the industry considerable further capital expenditure will be necessary for buildings, plant, machinery and equipment. Our technical strength and financial resources will enable us to meet the present-day conditions and we shall be well equipped to take advantage of any improvement in trade which may eventually arise.

The report and accounts were adopted.

THIS NARITE DIE PRODUCED, AT THE RATE OF 1,500 PER DAY, OVER 250,000 STAINLESS STEEL SINKS

LESS WEAR
LESS WASTERS
MORE PRODUCTION
MORE PROFIT

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Universally accepted as the greatest advance ever made in die metal technique. Ask for revised brochure, giving full details and latest technical information.

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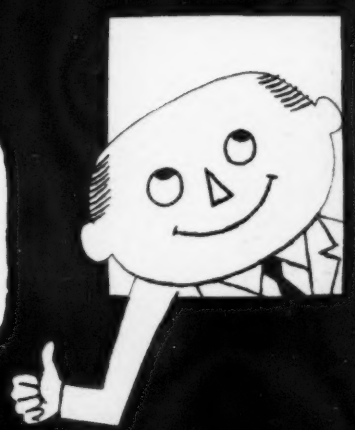
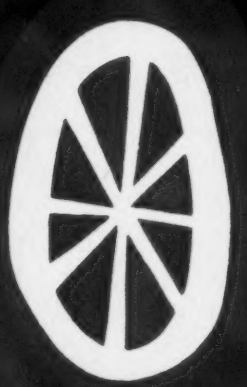
STAND No. 1C.9

ECO



Hey! That's a remarkable month's output. And you're raising it higher? Hold tight! Quicker - one two, one two . . . What? The grotnch sprocket spanned up? *!!!+!@!*— Call in one of those remarkably efficient PECO service teams. Ring MAC . . . Yes, I know, Your name's MAC and mine's Pete PECO. But ring it. MACaulay 1212. M-A-C one two, one two. Help will arrive in a flash. Remember: PECO get you running quicker.

PECO die-casting machines with their large capacity really do achieve phenomenal output. See for yourself. Look at the 'specs.' Piston drawings are included. Telephone now. They'll be on your desk in the morning.



We index alle Erzeuger von Spritzgussteile in Deutschland etc. von dem kostenlosen Nutzdienst der Firma PECO Osterreich in Anspruch. Fernadresse 2-3312

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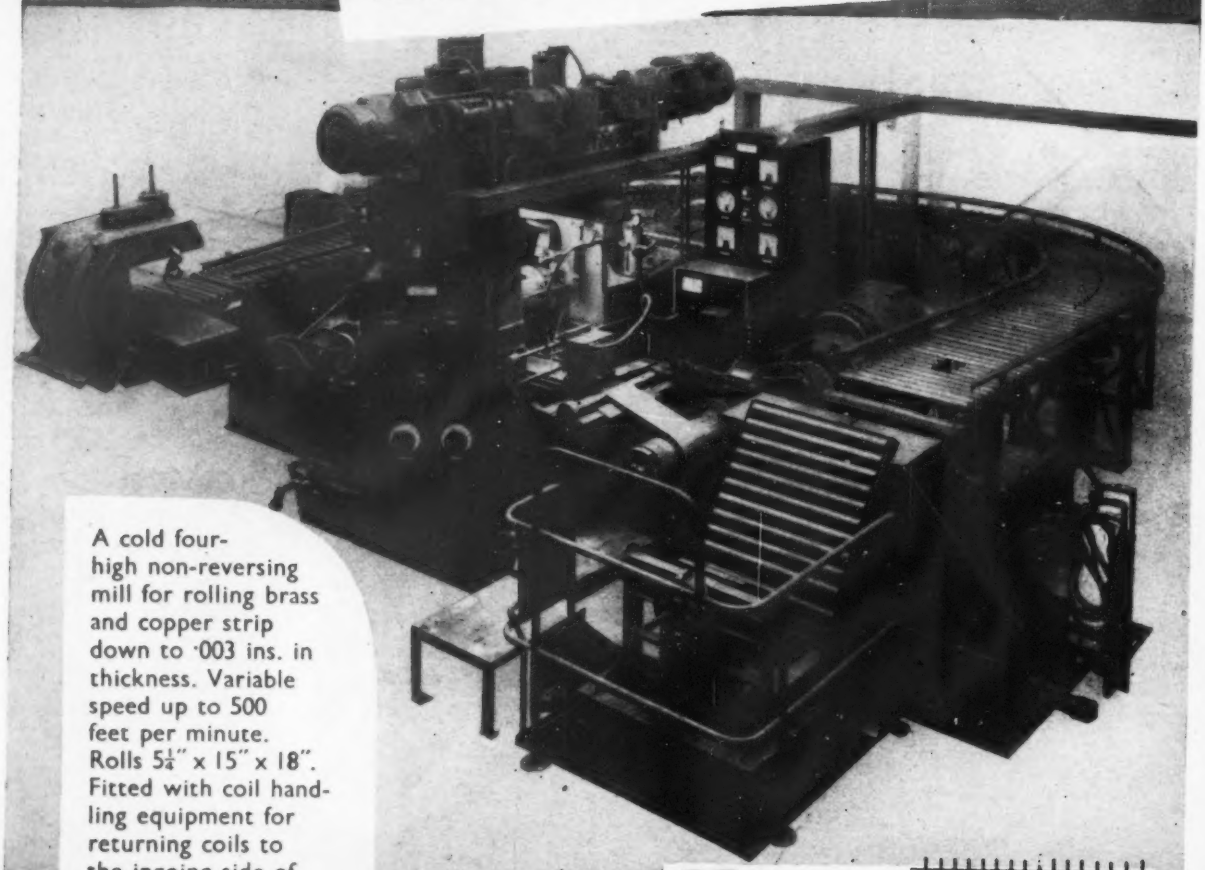

A cold four-high non-reversing mill for rolling brass and copper strip down to ·003 ins. in thickness. Variable speed up to 500 feet per minute. Rolls 5¼" x 15" x 18". Fitted with coil handling equipment for returning coils to the ingoing side of the mill

Speed and PRECISION

Photograph by courtesy of Messrs. D. F. Tayler & Co. Ltd., Birmingham

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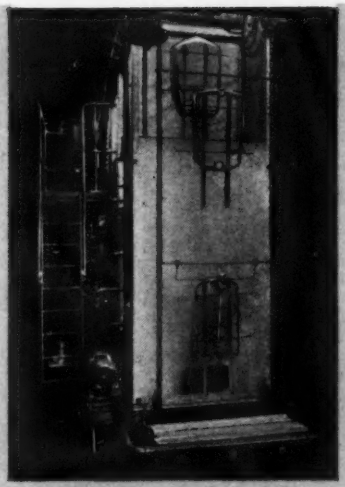
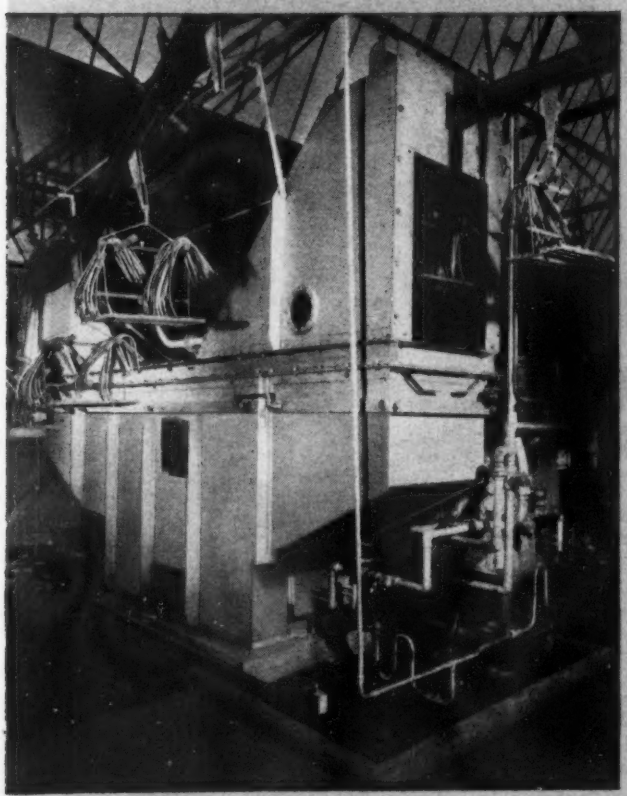


1933

Morris Motors Ltd. installed one
of the first-ever continuous I.C.I. metal degreasing plants.
This was arranged for degreasing radiator shells,
hub caps, etc. after polishing, and provided liquor,
vapour and jetting treatment with trichloroethylene.
After 24 years this plant continues
to give excellent service, degreasing approximately
30,000 assorted articles per week.

One good plant sells another



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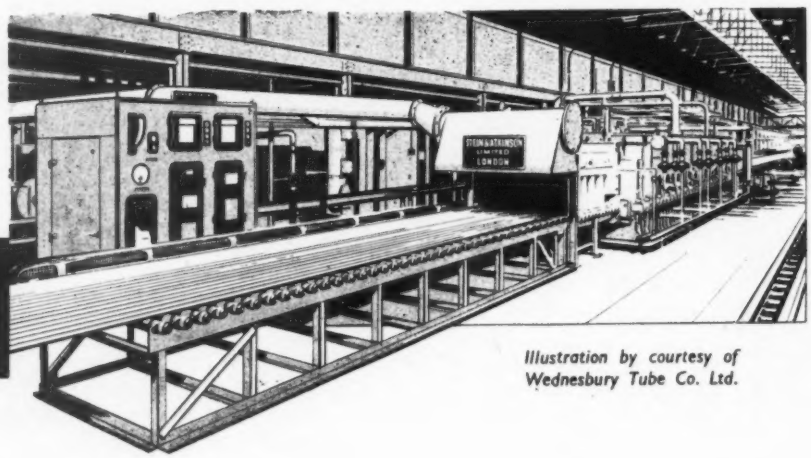
The illustrations shew (1) an automatically controlled Rotating Hearth furnace with fully automatic hydraulically operated charging and discharging equipment and (2) an automatically controlled Roller Hearth tube annealing furnace, in which the atmosphere is maintained by an inert gas screen.



TUBE ANNEALING

Illustration by courtesy of Wednesbury Tube Co. Ltd.

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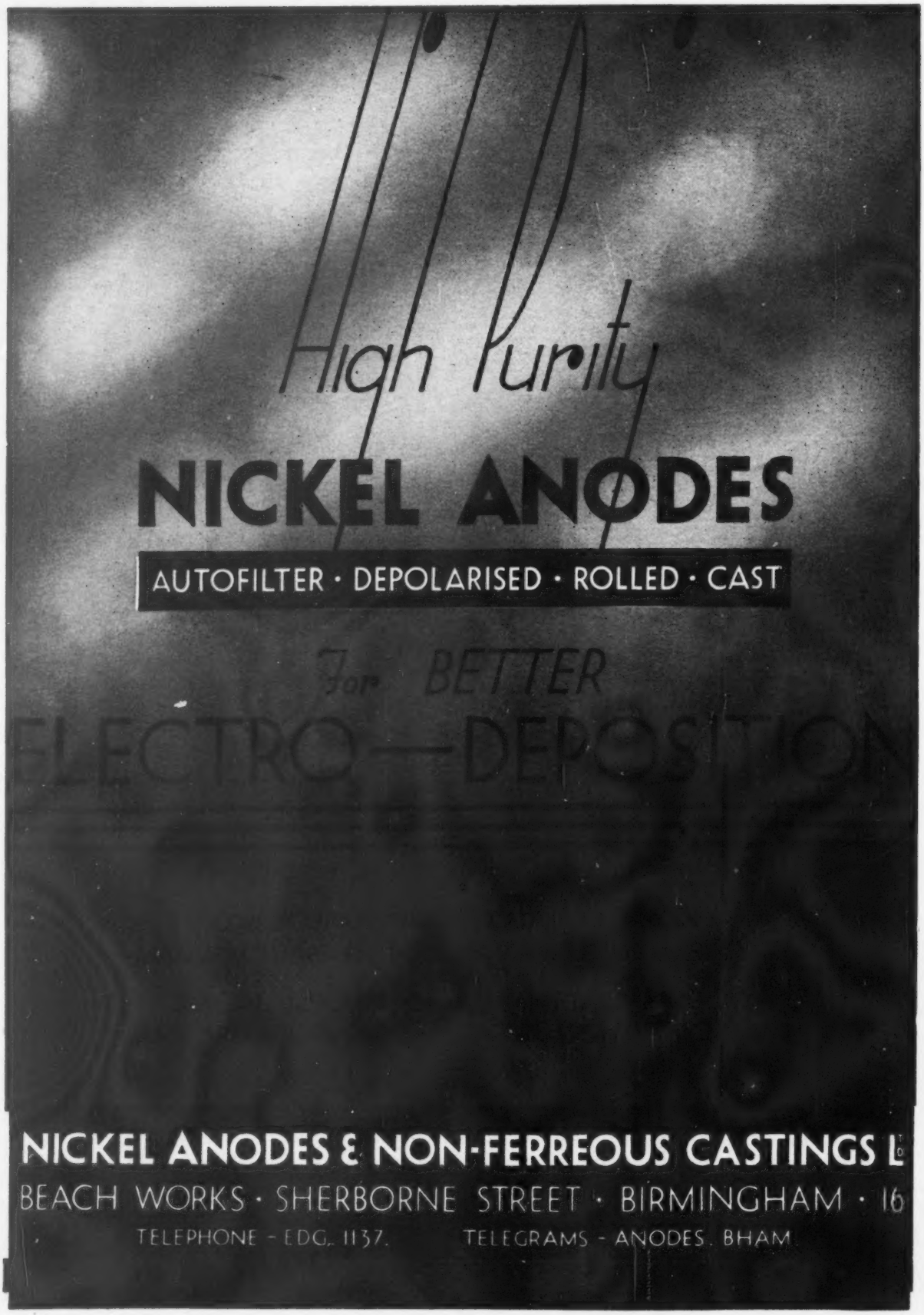
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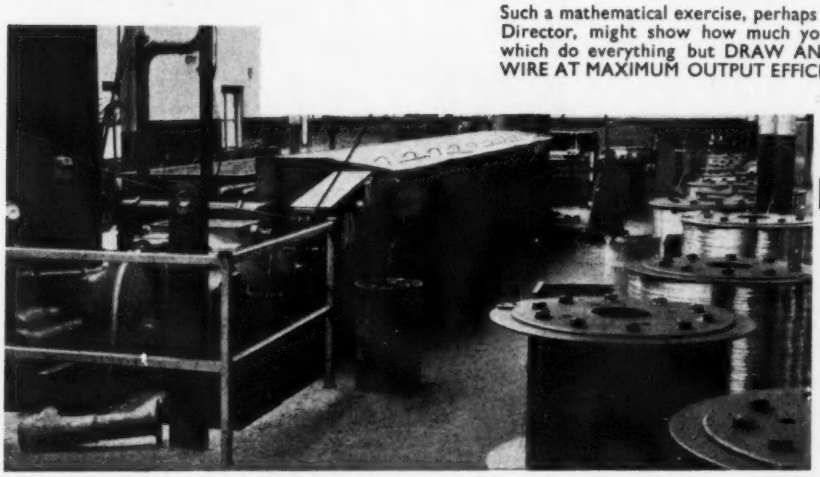

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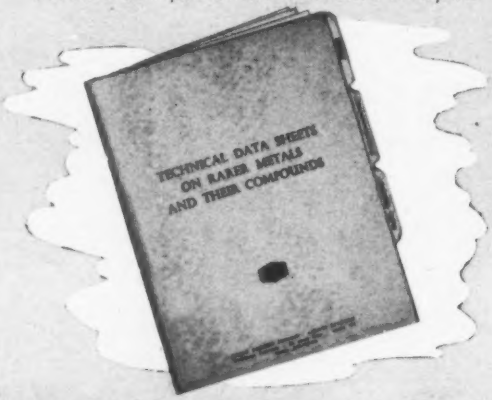

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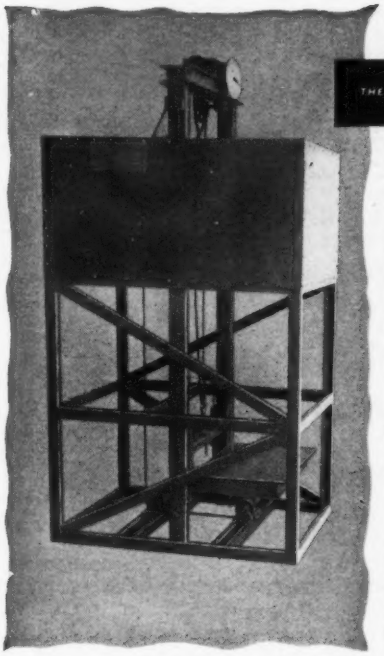

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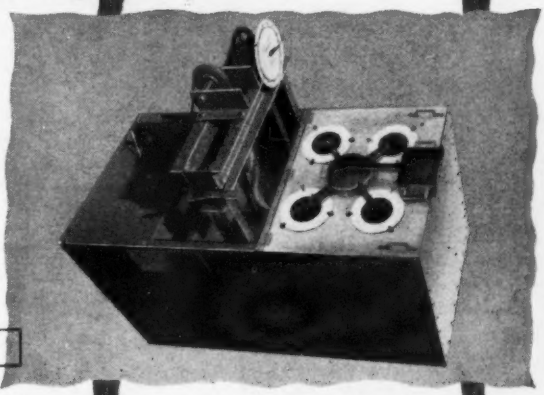

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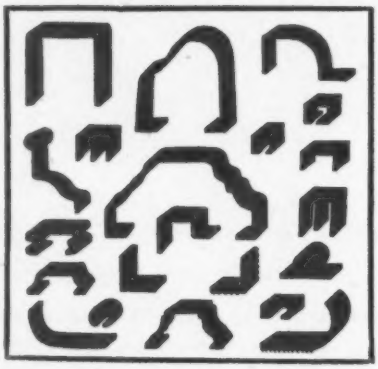

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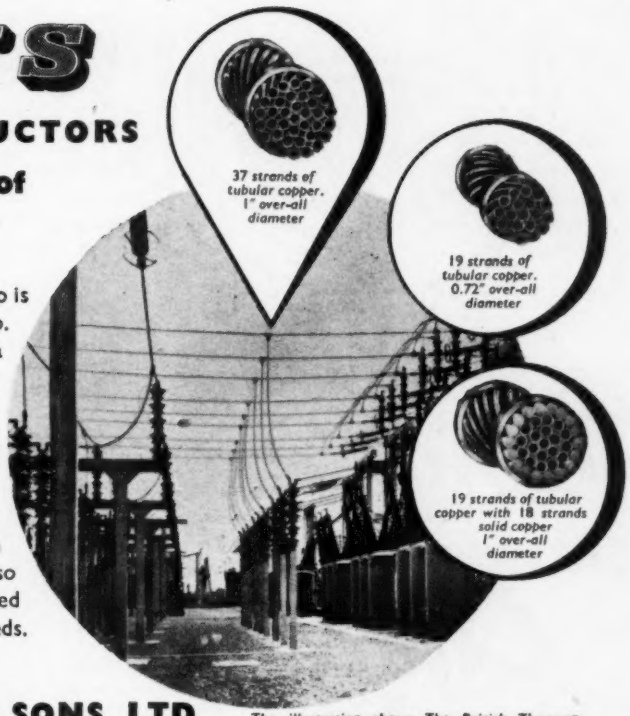
37 strands of tubular copper. 1" over-all diameter
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The illustration shows The British Thomson-Houston Co. Ltd. 132-kV, 3,500 MVA switchgear at Castle Donington Power Station of the C.E.A. (East Midlands) incorporating the 37-strand tubular conductor.
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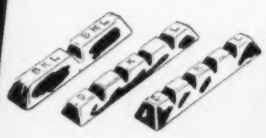

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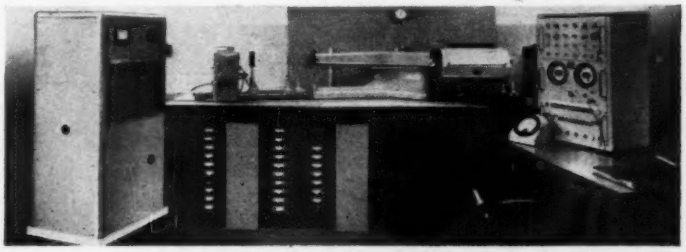
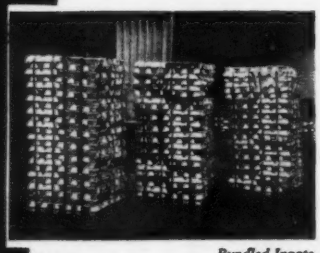


Spectrograph at Kings Norton Works



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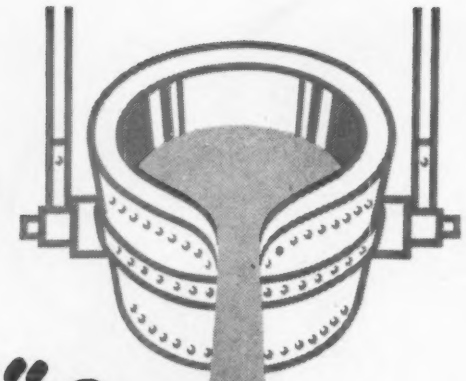

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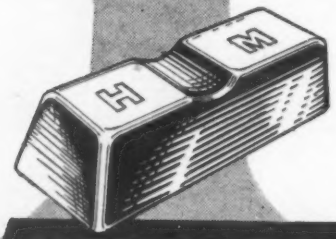

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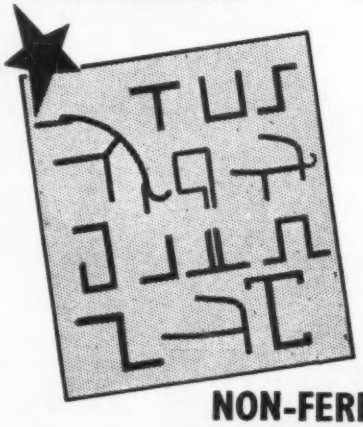

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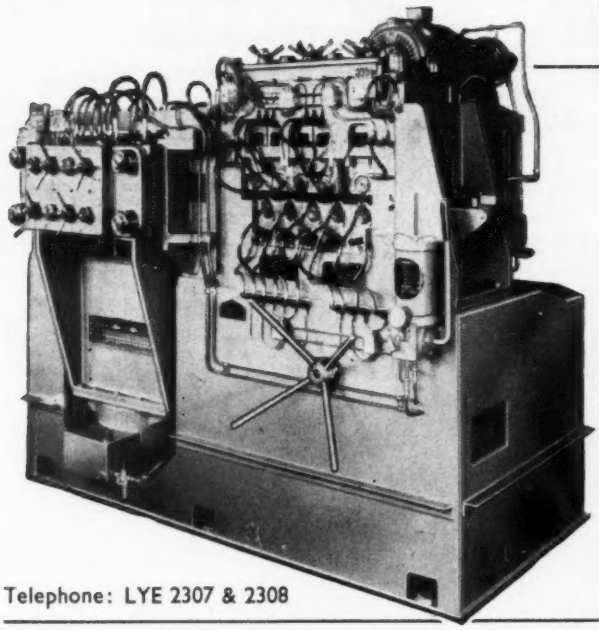

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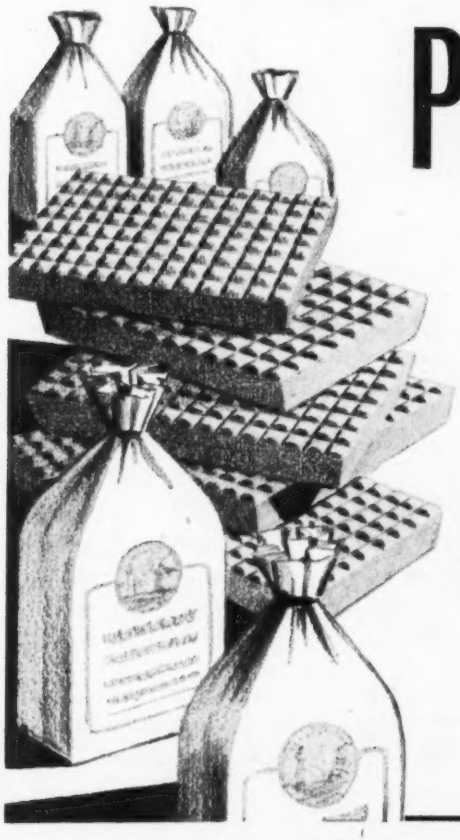

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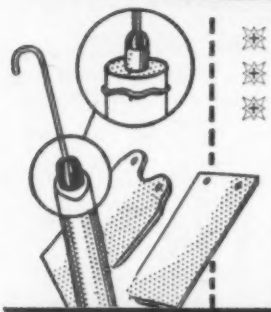

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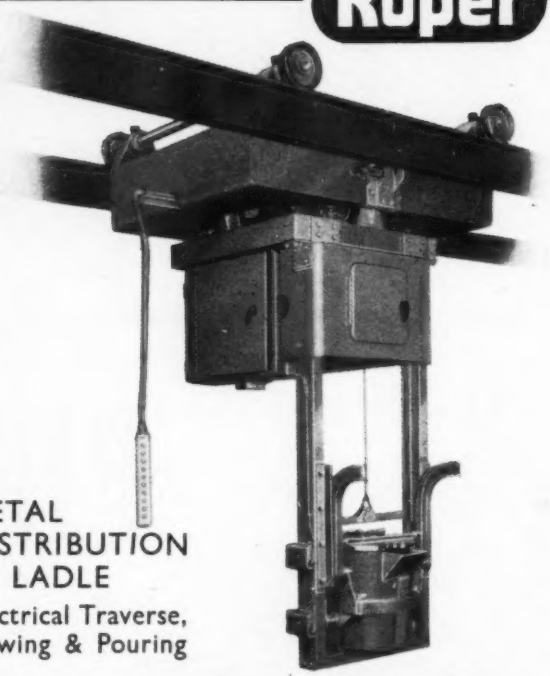

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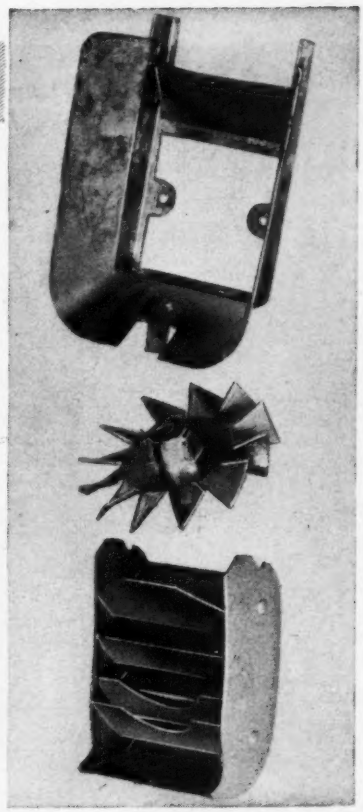

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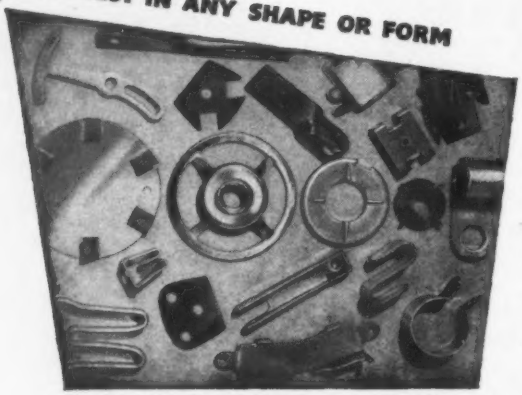

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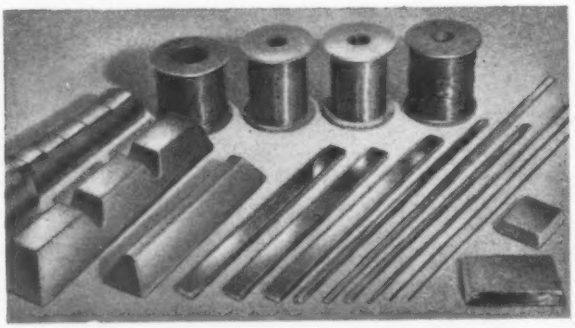

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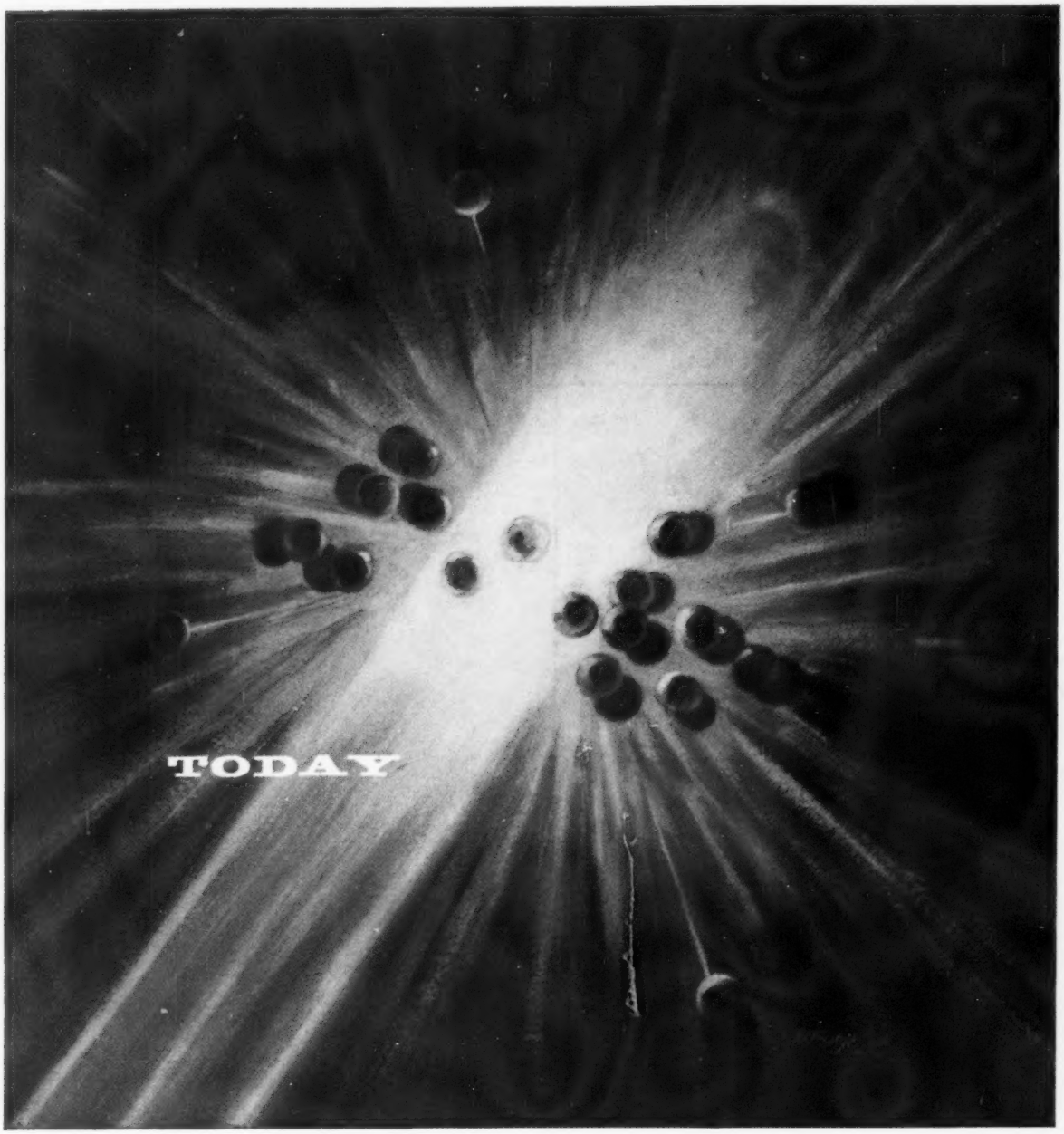

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